NGCP
CONNECT + CREATE + COLLABORATE

QuantumGirls: Resources and Activities to Celebrate World Quantum Day

April 1, 2025

NGCP Vision

The vision of the National Girls Collaborative Project is to **support and create STEM experiences that are as diverse as the world we live in**.

NGCP Resources

- **National Webinars**
  - Offered regularly on relevant topics, speakers include educators, researchers, authors, and diverse STEM professionals
- **Monthly Newsletter**
  - National events, STEM resources for girls and youth, professional development opportunities for educators, and research and reports
- **NGCP Website**
  - Exemplary Practices pages on Engaging Girls in STEM and Access and Equity, blog posts, and statistics and research related to girls and women in STEM

NGCP Podcast: Inspiring Curiosity from Early Childhood to Break Gender Stereotypes

In our first episode, we explore the crucial role of early childhood experiences in shaping girls' interest and engagement in STEM

5 Ways to Be an Ally to Girls and Women in STEM

If you think of gender equity in STEM as a “women’s issue” we encourage you to think again!

QuantumGIRLS

Out-of-school time quantum activities for middle school girls

The QuantumGirls curriculum was developed by the National Girls Collaborative Project in partnership with Montana State University Applied Quantum CORE with support from the US Air Force Research Laboratory and the National Science Foundation Engines Program.

NGCP

MONTANA STATE UNIVERSITY
Science Math Resource Center

QCORE

AFRL
THE AIR FORCE RESEARCH LABORATORY
LEAD | DISCOVER | DEVELOP | DELIVER

NSF National Science Foundation

QuantumGirls

- Middle school girls (around ages 11-14)
- Out-of-school time settings (e.g., after-school clubs, camps, enrichment programs, etc.)
- 10 1-hour modules + supplementary resources
- Designed to spark girls' interest in and identification with STEM, **not** to teach or evaluate girls on any specific STEM skills or content. Central goals are to:
  - Expose girls to quantum related careers
  - Spark girls' interest in quantum topics
  - Foster girls' STEM identity - Perceived competence in STEM and self-recognition as a "STEM person"

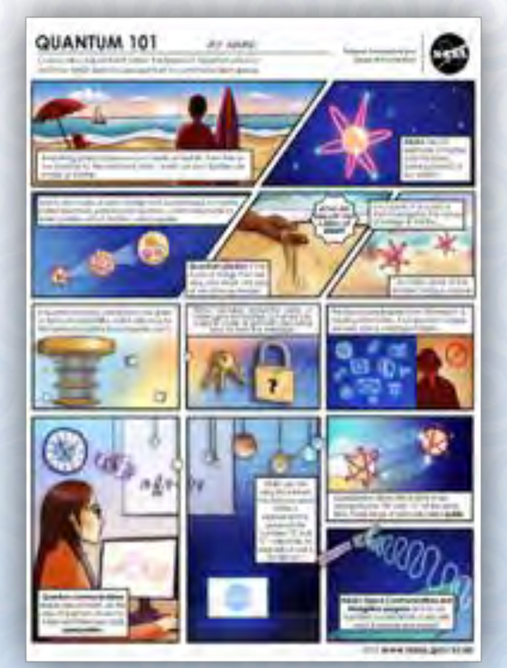
Core Components

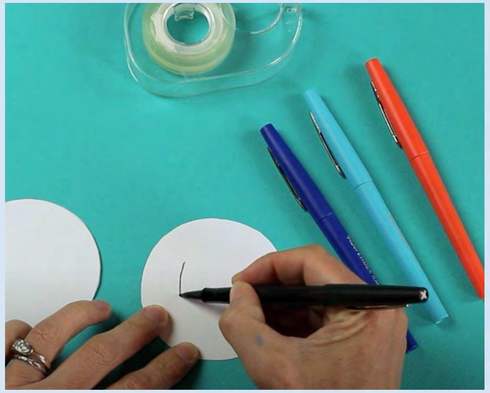
Each one-hour module includes…

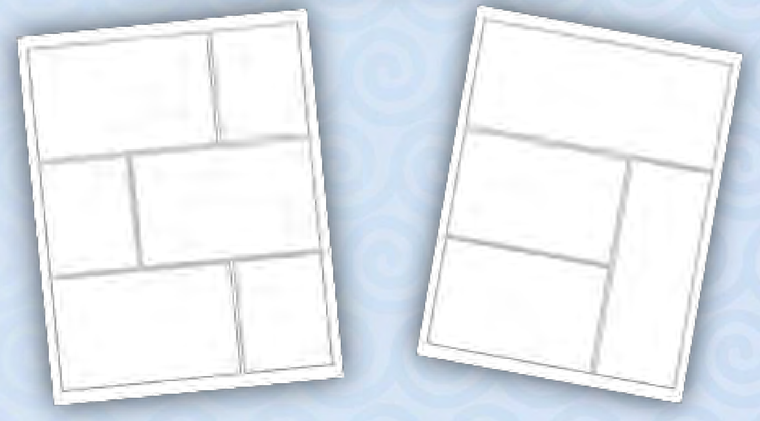
- **Icebreaker** – Short discussion-based activity to pique girls' interest and build girls' comfort
- **Concept introduction** – Video clips and discussion prompts on new concepts being introduced
- **Hands-On Activity –** Hands-on activity that uses free or low-cost materials
- **Career Connection** – Connect concepts to real-world careers
- **Role Model Moment** – Learn about women in quantum related fields through short video clips
- **Closing Discussion** – Chance to debrief and reflect

Activity Examples

- How small is an atom paper cutting activity
- Quantum graphic novel / comic strips
- Thaumatropes as a physical example of superposition
- Writing encrypted messages
- ...and lots more!







Speakers

Hilary Lozar

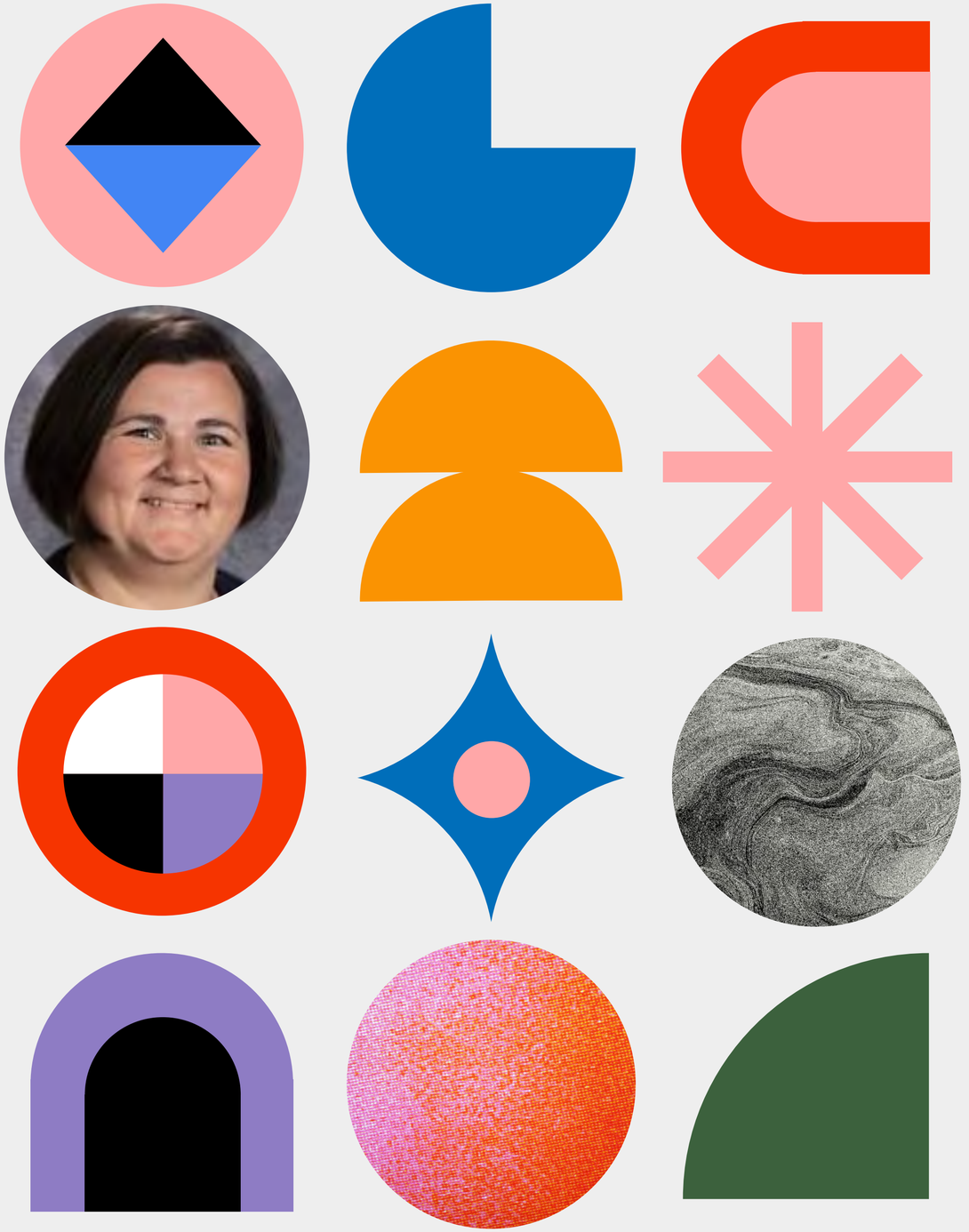
Boys and Girls Club of Flathead Reservation

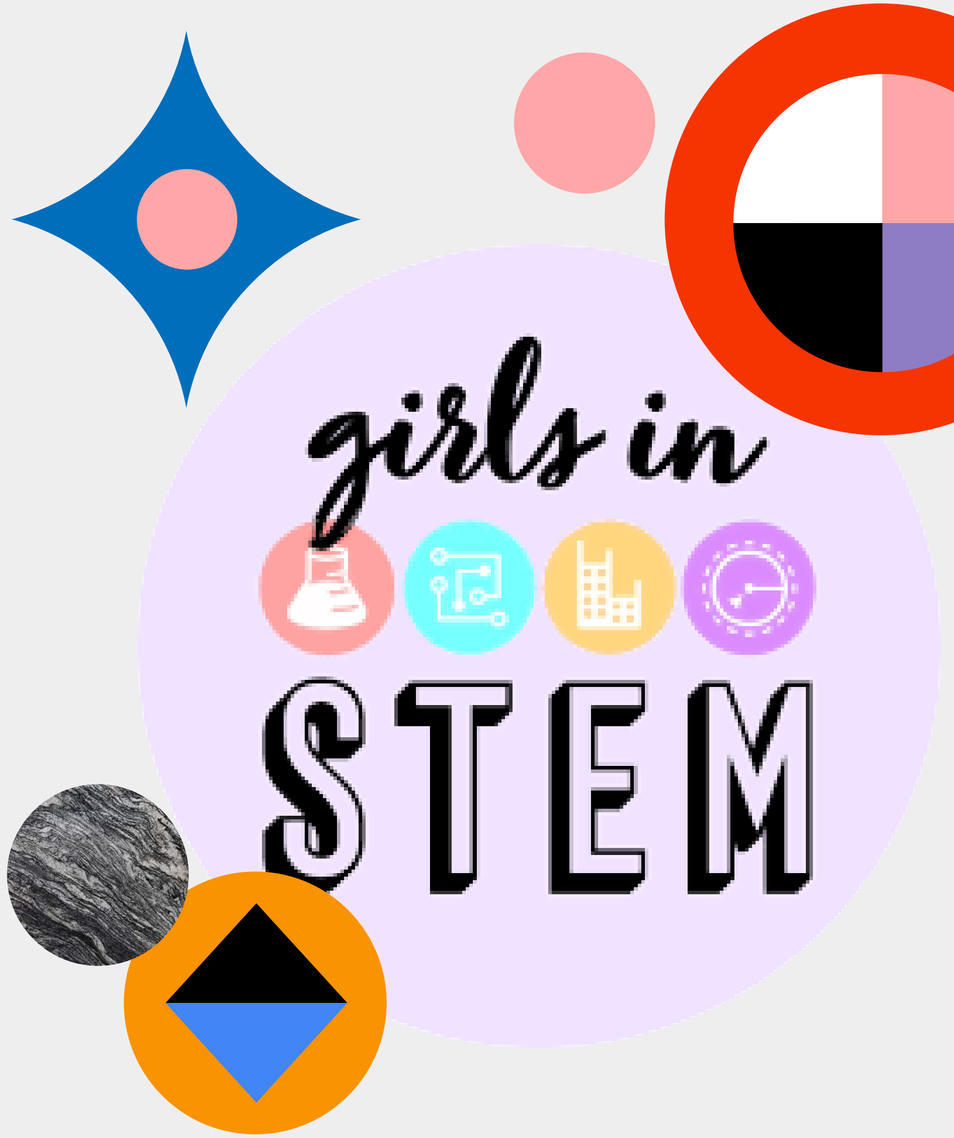
Jennafer Day

Monforton School

Quantum Girls

Monforton Middle





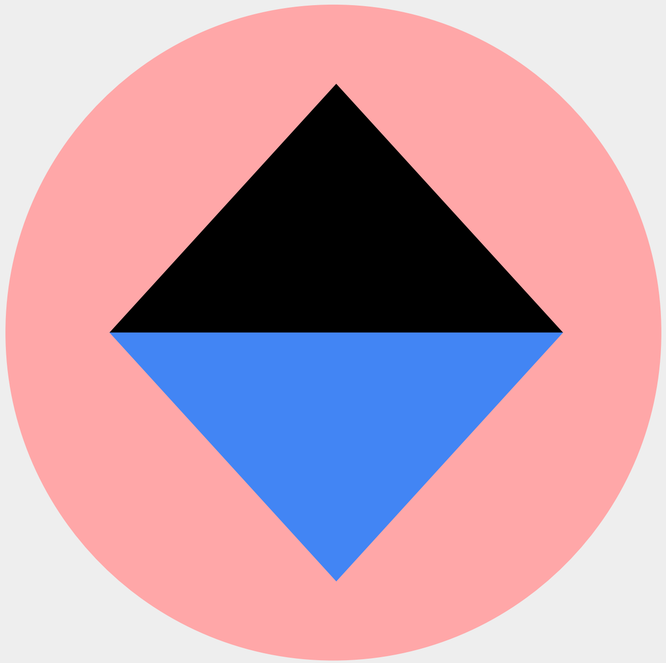
Motivation for Quantum Girls

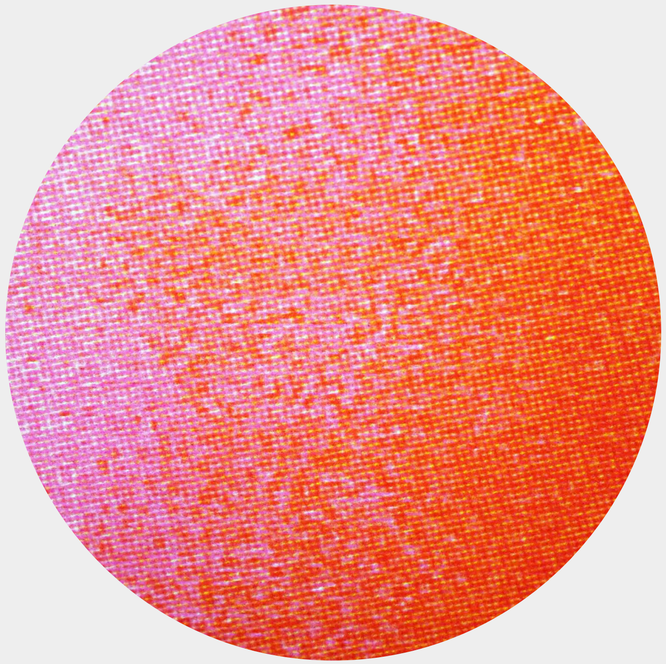
Personal: I am fortunate enough to work in a school that has an entire science department of females. Growing up, I did not have one single female science teacher. While I did not think much of it at the time, as I was preparing for college, It was in the back of my mind that “professional” science was for males

- School Community: We have a lot of students whose parents are faculty/staff at MSU. With that connection, many of our girls are involved in camps and programs put on by the University, so this felt like a natural extension. Our students are inquisitive, motivated and I truly believe will be leaders in the future.

Quantum Girls at Monforton

- Advertised in class and on school newsletter, open to all 6-8th graders
- 9 students enrolled
- After school, 10 sessions 1 time per week
- Went through all 10 modules and had a project showcase at the end for school staff, parents and MSU staff



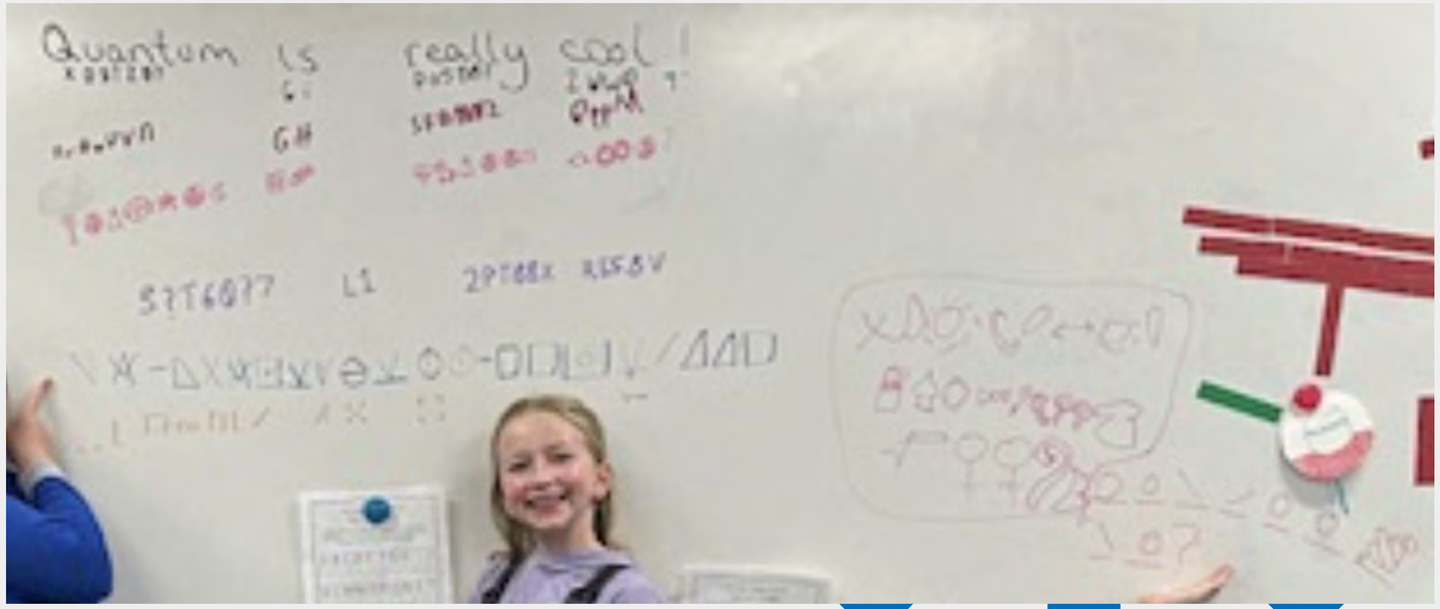


Modules

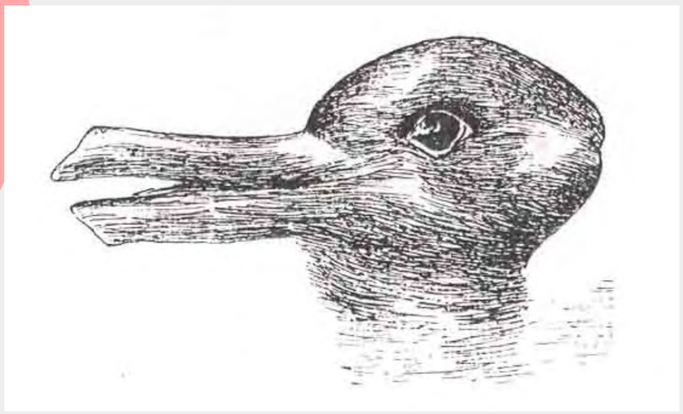
*__Module 1__: What is Quantum?
* paper cutting activity
*__Module 2:__ What is Quantum Science and Technologies?
* quantum comic book
*__Module 3:__ What is Quantum Computing?
* thaumatropes
*__Module 4:__ Science Fiction... Or is it?
* sci-fi movie posters
*__Module 5:__ How are the Arts Connected to Quantum?
* Superposition art

*__Module 6__: Why Does Quantum Matter to Me?
* voter fraud, secret codes
*__Module 7__: What Can You Do with A Career in Quantum?
*Quantum job advertisement
*__Module 8 & 9__: Quantum Girls Final Project
* skits, slideshows, posters, etc
*__Module 10__: Quantum Girls Project Showcase
* presented to school staff, school board, parents, MSU faculty

Quantum Cryptology



Superposition Art



Program

Takeaways

Highlights

- Inquisitive nature of the girls often led to discussions that extended the lessons
- Pride the girls took in knowing high level material that even their teachers didn’t know

Favorite Activities

- Sci-Fi Quantum Movie poster
- Thaumatropes
- Quantum videos for all ages
- Final Project

Benefits for girls

- Confidence in difficult material
- Exposure to cutting edge careers
- Realizing application of quantum in their everyday lives
- Role Model Moments

MY EXPERIENCE WITH QUANTUMGIRLS

Hilary Lozar, STEM Coordinator

Boys & Girls Club of the Flathead Reservation & Lake County

A BRIEF BACKGROUND:

STEM Educator
- Masters in Science, Science Education from MSU (Go Cats!)
- Taught elementary STEM for 5 years in public education, now with Boys & Girls Club

Lifelong Learner
- Piloting programs
- Seeking out new experiences for myself as well as my students

Science Nerd
- Always loved science classes
- Science teachers were my role models

Astronomy Enthusiast
- Always dreamed of being an astronaut
- Still want to go to space!

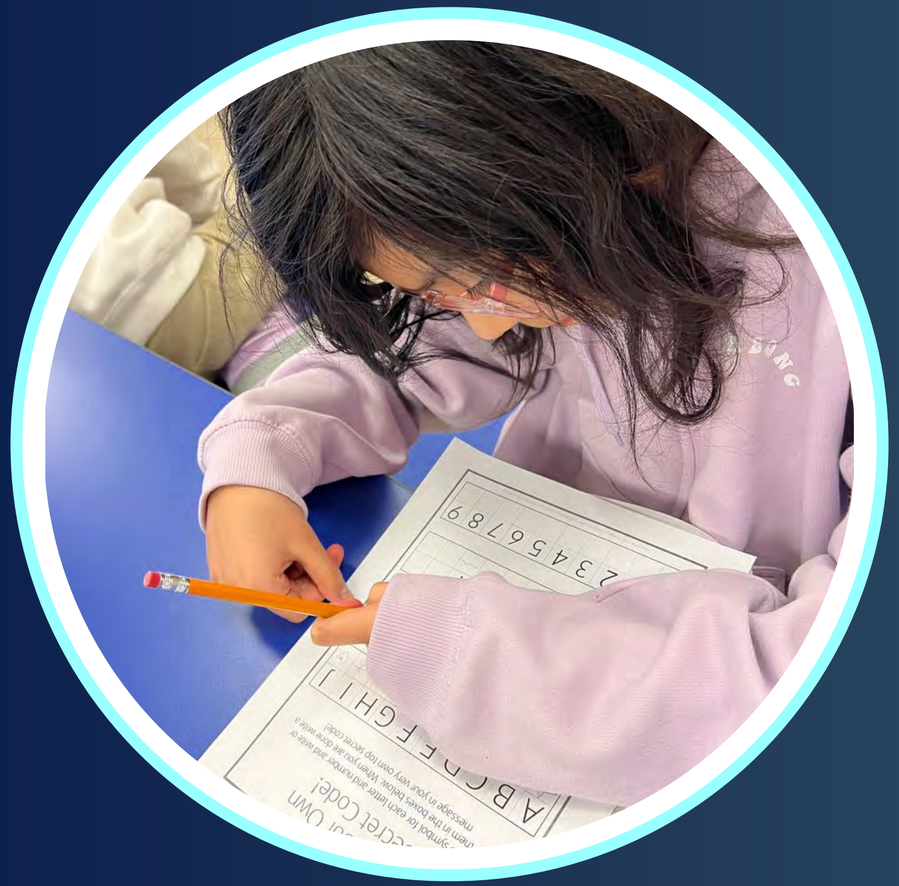
STEM Mentor
- Vital role in today's world
- Mentors make a difference!

QG HIGHLIGHTS

- All the art! The girls REALLY love the artistic components of this program.
- So many questions! Even my shyest girls show deep curiosity and will ask!
- Interesting applications! The girls got very creative with how quantum can be used!
- Secret Codes! The girls LOVED creating and breaking codes! We still write notes!
- Relationships! These girls are not BFFs. But they work together very well!
- Personal twists! Each girl's ideas are specific to their hobbies!

QG CHALLENGES:

- Time! There is just never enough!
- Consistency! We often have schedule conflicts with other Club groups that the girls want to participate in.
- Relatability! Some of these concepts are pretty mind-bending!
- Recruitment! Our membership fluctuates with sports seasons and other out of school activities.
- Retention! Some of the concepts and vocabulary needed to be used more frequently to stick!



QG INSIGHTS:

- These girls want to know more! They just keep asking great questions!
- These girls want to teach others! They take joy in educating their peers!
- These girls gained confidence! They speak up and they speak often!
- These girls gained knowledge! They are proud of their new concepts and vocabulary!
- These girls built relationships! They enjoy each other's company!
- These girls are creative! Their personal insights are inspirational!
- These girls are artistic! They understood the assignment!
- These girls may or may not use quantum in their futures, but they won't be afraid to try!

QG TIPS AND TRICKS:

1.

Use analogies!

These concepts can be very abstract, so try to come up with anaologies your students can relate to!

2.

Use models!

The penny model works well to explain superposition. Try to incorporate more physical models for other terms!

3.

Be excited!

Quantum can sound scary! If you're excited to learn alongside your students, they will fear it less!

THANK YOU!

I have enjoyed working with these girls, and have really enjoyed learning more about quantum sciences, technologies, and applications. I look forward to continuing working with this curriculum in the future, as well as answering any questions about it and its implementation in an after school setting!

SCAN FOR MY CONTACT INFO!

hilary@flatheadbgc.org

Quantum Activity Resources

Hands-On Activities:

- Find tutorials for doing quantum physics activities from your kitchen, basement, or school: Spooky Action Book
- EPQIC activities: EPiQC Activities for Informal Educators
- Quantum Jewels activity guide: Quantum jewels: crafting colorful diamonds and graphene with marshmallows

Printable Activities:

- NASA Scan: Quantum Code Crunchers
- NASA Scan: NASA's Quantum 101 comic sheet and Quantum 101 Coloring Sheet

Digital Games:

- Quander: https://iqim.caltech.edu/quantum-puzzles/

Websites

- https://worldquantumday.org/
- https://www.aps.org/
- https://engage.aps.org/stepup/curriculum/careers/matching
- National Q-12 Education Partnership (q12education.org)
- 52 Wonder Women Working In Industry As Quantum Scientists & Engineers
- https://quantumforall.org/
- https://girlsinquantum.com/
- PBS Learning Media – Quantum Resources

Videos

- This Is Quantum
- What YOU can do with quantum science
- Mission Unstoppable: What is a Quantum Computer?
- Working in Quantum Video Series (Playlist Link)
- Quantum 101 Series (Playlist Link)
- Quantum Mechanics Explained in Ridiculously Simple Words
- Working in Quantum | Ilana Wisby (Oxford Quantum Circuits)
- Adventures in Quantum Computing with Dr. Anne Matsuura
- Adventures in Quantum Computing with Dr. Jessica Torres
- Adventures in Quantum Computing with Dr. Stephanie Bojarski

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