Strategies for ENGAGING *Underrepresented Girls* in STEM

TEXAS WOMEN AND GIRLS IN STEM SUMMIT
BREAKOUT SESSION 4 | 2:30PM - 3:20PM

http://bit.ly/TheGEMSCampDeck

Dr. Judith Quander, Associate Professor of Mathematics Education
University of Houston - Downtown

Saki L. Milton, MBA, Founder & Executive Director
The GEMS Camp (Girls interested in Engineering, Mathematics, and Science)

underrepresented

Students from demographic groups whose representation in STEM fields and industries does not mirror regional and national focus populations specifically, women, African American, Native American, Hispanic, and Pacific Islander students for which systems have provided insufficient or inadequate balance of opportunity (NRC, 2013).

underserved

Students are those whom systems have placed at risk because of their race, ethnicity, English language proficiency, socioeconomic status, gender, sexual orientation, different ability, or geographic location (NRC, 2013).

Today's Learning Outcomes

- To share The GEMS Camp's holistic model for engaging girls in STEM
- To explore how STEM learning ecosystems can support girls
- To gain a an understanding of culturally relevant pedagogy
- To brainstorm framework strategies for formal and informal settings

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Today's Agenda

● What is The GEMS Camp?	10 minutes
● What are STEM Learning Ecosystems?	15 minutes
● What is Culturally Relevant Pedagogy?	5 minutes
● Activity: Building Frameworks that Support Girls of Color	15 minutes
● Q&A	5 minutes

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The mission of The GEMS Camp (Girls interested in Engineering, Mathematics, and Science) is to build confidence in urban teen girls in grades 7-12 through five core areas called the *5 Karat Gems - Academics, Career, Creativity, Leadership, and Service* - so that they will be successful in STEM studies and careers.

The GEMS Camp

Girls interested in Engineering, Mathematics and Science

2010
year founded
The organization received its 501(c)3 status in 2014.

9 camps held since inception

Dallas

Houston

430 girls served since 2010

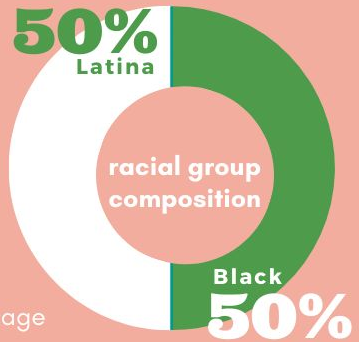
FOCUS

Our Clients

Statistically, girls of color, especially those from economically disadvantaged communities, experience the brunt of the unequal distribution of and access to quality STEM learning experiences over their lifespan. GEMS' student demographics reflect our commitment to helping close the gender, racial, and socioeconomic gaps in STEM.

90%
Low Income
Free/Reduced Lunch

60%
ESL students
English Second Language



Our Reason

- In the U.S. workforce, only 29% of science and engineering employees are female, although women make up half of the total U.S. college-educated workforce (National Center for Education Statistics, 2018).
- Black women, Latinas, and other women racially underrepresented in STEM comprise fewer than 1 in 20 employed scientists and engineers (National Science Foundation, 2018).
- Only 15% of Black students and 17% of Hispanic students took advanced math and science high school courses (NSF, 2018). Students attending the poorest high schools have the least access to physics, computer science, statistics, and calculus, including AP for all four subjects (NAEP, 2015).
- Students attending the poorest high schools have the least access to physics, computer science, statistics, and calculus, including AP for all four subjects (NCES, 2018).
- Summer learning loss ("summer slide") can leave low-income students 2.5-3 years behind their peers. Students who fall behind over the summer are less likely to graduate from high school or go on to college (National Summer Learning Association, 2018)

IMPACT

Our Results

The GEMS Camp incorporates the measures of quality STEM out-of-school programs recommended by the National Academy of Sciences: academic development, positive STEM identity, and expansion of individual awareness, connections, and choices (in the context of lifelong, academic, and career engagement). Since its infancy, GEMS continues to gain momentum organically, while maintaining authenticity to our mission. From math and science scores to community service hours, our metrics capture our summer programming effectiveness through a variety of tools: observations, surveys, interviews. Specifically, we measure our impact on girls' STEM knowledge, attitude and identity, engagement, and interest. Take a look at a snapshot of our 2019 numbers.

KNOWLEDGE & SKILL

96 HOURS of coding through code.org

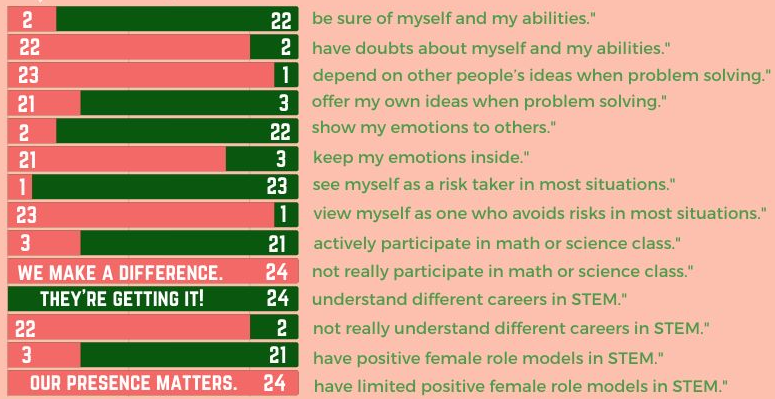
90 AVERAGE SCIENCE SCORE

42% INCREASE

shown on math pre- and post-assessments for next grade level targeted Texas State Standards , TEKS, that were previewed during the 2018 summer program of 24 girls.. 70% mastered pre-test, while 85% mastered post-test.

ATTITUDE & IDENTITY

Complete the statement, "____ GEMS, I tend(ed) to..."



ENGAGEMENT

15 high school and college mentors

VOLUNTEERED **1500** HOURS OVER ONE WEEK.

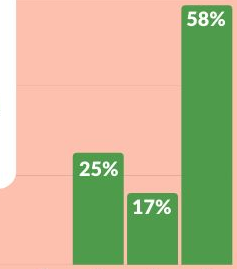
12 GIRLS EXPLORED THE UNITED ARAB EMIRATES ON THE GLOBAL STEM TRAVEL *experience.*

447 POSTS	372 TWEETS	82 POSTS	100 POSTS
2598 INTERACTIONS	206 INTERACTIONS	485 INTERACTIONS	200 INTERACTIONS
35.8K REACHED	23.7K IMPRESSIONS	70 NEW CONNECTIONS	100 NEW FOLLOWERS

33 GIRLS PARTICIPATED IN THE SUMMER CAMP *experience.*

INTEREST

"On a scale of 1 to 5, after participating in The GEMS Camp, I am more interested in studying a future career in STEM (i.e. engineer, scientist, technologist)."



PROGRAMS

Unlike most traditional STEM programs that focus mostly on hands-on, project-based activities, GEMS takes a holistic approach to providing girls with two experiential learning programs, incorporating research-based best practices for bringing girls from underrepresented populations into the STEM career pipeline. The GEMS Camp Summer Experience services 30 middle school girls each summer (10 students/grade level; rising 7th-9th). "Gems" (a.k.a. participants) engage daily in learning and confidence building activities through the 5 Karat Curriculum Framework.

$125
COST PER STUDENT

Accommodations– overnight secure stays in shared dormitory room with separate beds.

3 meals/day; variety of cuisines and prepared by university

Residential Boarding– overnight secure stays in shared room with separate beds.

3 meals/day; variety of cuisines and prepared by university

SUMMER CAMP EXPERIENCE
TENTATIVE JULY 19 - 25, 2020

DALLAS LOCATION:
THE UNIVERSITY OF NORTH TEXAS AT DALLAS

FORT WORTH LOCATION:
LAUNCHING 2020!

MIDDLE SCHOOL — 30
Camp participants are called "Gems"

HIGH SCHOOL & COLLEGE — 12
Volunteer mentors are called "ruby" and "diamond" leaders

4
Certified math or science teachers

1. Academics

3 hours per day of authentic problem-based learning led by state certified teachers.
Activities can include:

- Preview upcoming year's state math and science concepts
- Practice independently via online course modules
- Learn effective study and note-taking techniques
- Receive small-group academic tutoring from mentors

2. Career

0.5 hour per day developing 21st Century career skills facilitated by leading local STEM practitioners. **Activities can include:**

- Learn career strategies and hear engaging personal anecdotes from STEM women
- Identify and complete a GEMS Career Exploration project of interest
- Practice 1-on-1 soft skills (i.e. interview, etiquette

3. Creativity

1.25 hours/day developing creativity skills as they complete STEM project-based learning tasks led by instructors and corporate volunteers. **Activities can include:**

- Learn and apply the engineering design process
- Work in collaborative teams
- Learn to apply STEM industry models for individual and group brainstorming techniques

4. Leadership

1 hour/meeting cultivating leadership traits in small group mentoring led by high school (rubies) and college (diamonds) STEM camp leaders.
Activities can include:

- Address adolescent issues unique to urban teen girls through situation-based fictional stories
- Learn appropriate conflict resolution strategies
- Participate in team building exercises to strengthen healthy female-female relationships

5. Service

0.5 hours of daily planning or participating in community service.
Activities can include:

- Plan, coordinate and execute a service learning STEM-based project:

CAPSTONE PROJECT

Gems complete and present a capstone project, highlighting their summer learning experience and STEM interests.

BALANCE & WELLNESS

"Be a Gem" time is a special 45-minute break when girls are surprised with mind, body, and soul activities led community volunteers.

R NY

Gems are recognized for individual achievements in front of their parents and community. The event also recognizes donors and corporate participation.

PROGRAMS

GLOBAL STEM TRAVEL EXPERIENCE
TENTATIVE AUGUST 2020

Introduced in 2018, former Gems and high school girls from across Texas applied to attend a two-week international STEM exploration trip. 8 high school girls were selected to travel to **Italy** (Naples, Rome, and Florence) to explore the "M" in STEM, studying geometric concepts of ancient and modern architecture, technology, and engineering.

In 2019, 12 girls traveled to the **United Arab Emirates** to explore innovation, environment, and sustainability. GEMS believes in order to diversify college campuses, underrepresented students must be competitive academically and experientially to stand out.

COST/STUDENT: $2,500 USD

The cost per student includes:

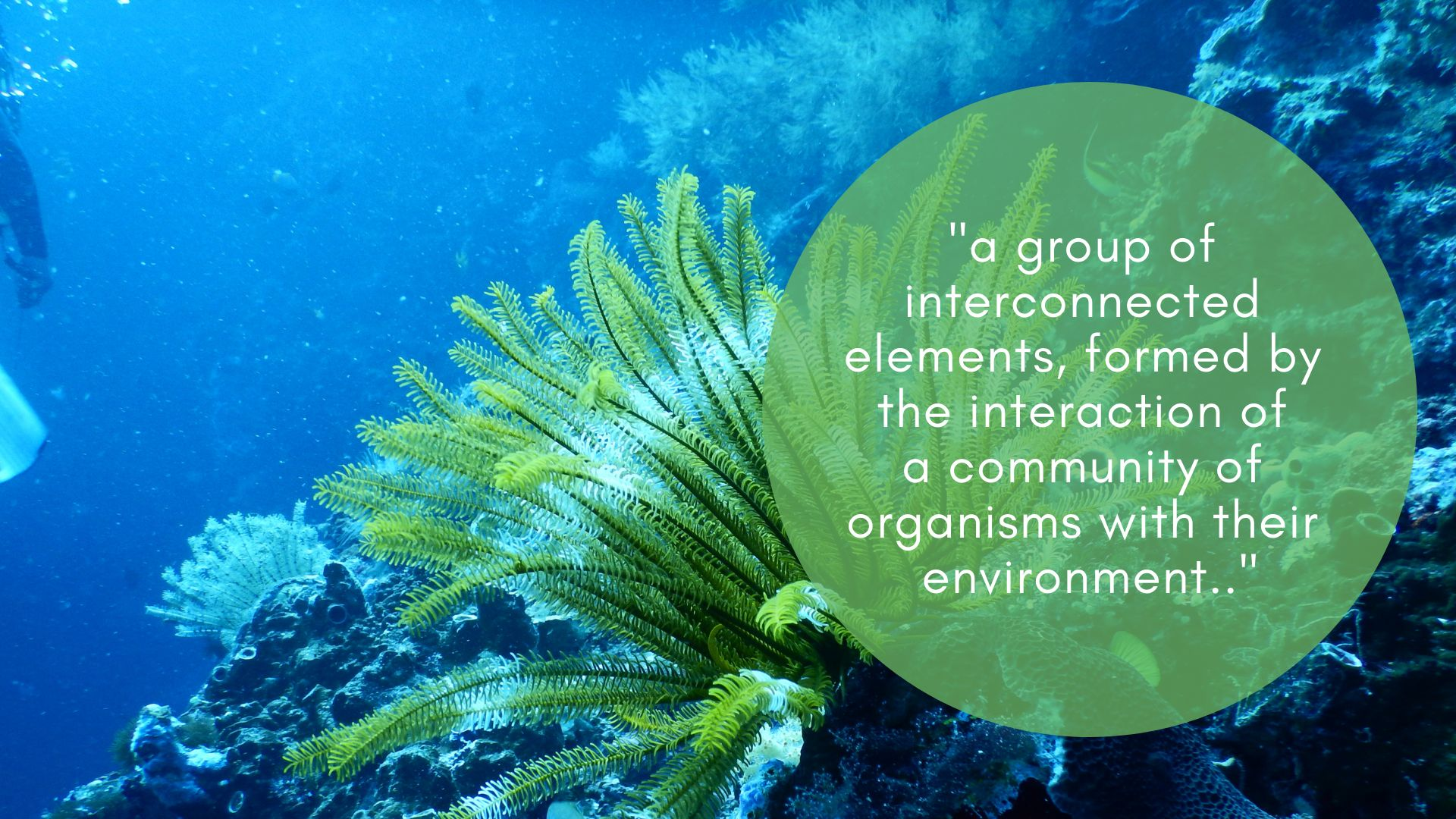
- Flight—Round-trip economy ticket between Dallas and Johannesburg and inter-continental flights
- Accommodation—15 overnight secure stays in shared room with separate beds
- Local transportation—Private bus, metro, and boat rides (where necessary)
- Entrances—National parks, museums, excursions, and safari
- Meals—3 meals per day
- Guides—Local guide, certified teachers, trip director

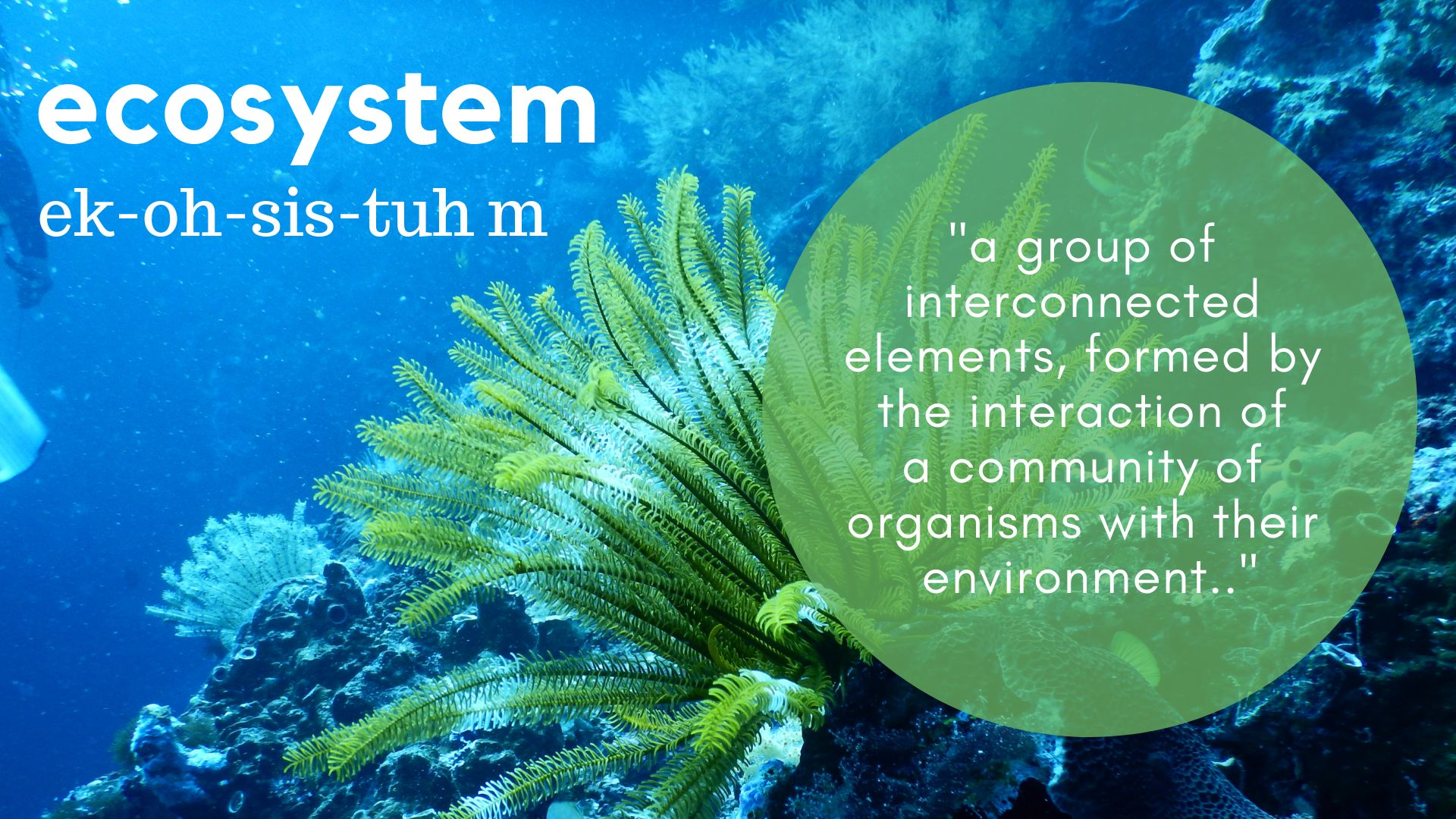
QUALIFICATIONS

- At least 16 years old
- Minimum 3.25 overall GPA
- Complete application and interview
- **Strong interest in studying a STEM field at university**

APPLICATION PERIOD: 10/15 - 12/01
PARTIAL SCHOLARSHIPS AVAILABLE

2020 | EXPLORING THE SCIENCES IN AFRICA


"a group of interconnected elements, formed by the interaction of a community of organisms with their environment.."


ecosystem
ek-oh-sis-tuh m
"a group of interconnected elements, formed by the interaction of a community of organisms with their environment.."

GLOBAL STEM PARADOX

It would be easy to blame schools and universities for not educating enough STEM students, but the problem is more complex. While there are greater numbers of STEM graduates worldwide than ever before, STEM jobs continue to go unfilled.

THE NEW YORK ACADEMY OF SCIENCES, 2014

STEM LEARNING ECOSYSTEM

"A STEM Learning Ecosystem encompasses schools, community settings such as after-school and summer programs, science centers and museums, and informal experiences at home and in a variety of environments that together constitute a rich array of learning opportunities for young people.

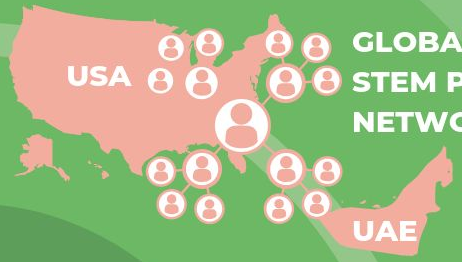
A learning ecosystem **harnesses the unique contributions of all** these different settings in symbiosis to deliver STEM learning for **all children**. Designed pathways enable young people to become engaged, knowledgeable and skilled in the STEM disciplines **as they progress through childhood into adolescence and early adulthood**."

THE GEMS CAMP

SOURCES: STEM ECOSYSTEMS.ORG
CHARTING A COURSE FOR SUCCESS: AMERICA'S STRATEGY FOR STEM EDUCATION, OFFICE OF THE WHITE HOUSE, COMMITTEE ON STEM EDUCATION OF THE NATIONAL SCIENCE & TECHNOLOGY COUNCIL, 2018.

STEM LEARNING ECOSYSTEM

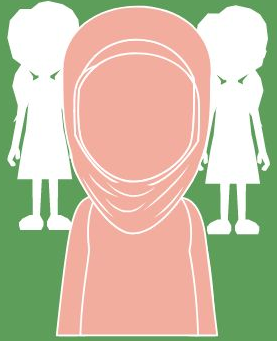
FEMALE STEM ROLE MODELS



GLOBAL STEM PEER NETWORKS

CORPORATIONS

MUSEUMS & LIBRARIES



THE GIRL LEARNER

SCHOOLS

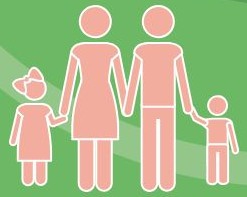
GOVERNMENT & MINISTRIES

21ST CENTURY SKILLS PROVIDERS

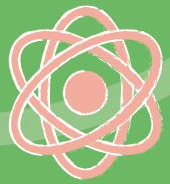
FAITH-BASED ORGANIZATIONS

UNIVERSITIES & COMMUNITY COLLEGES

FOUNDATIONS & NONPROFITS



FAMILIES



SCIENCE CENTERS

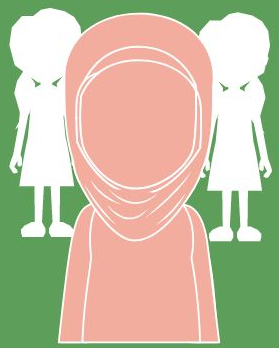
STEM LEARNING
ECOSYSTEM

GIRL AT THE CENTER

The model is student centered, where the girl

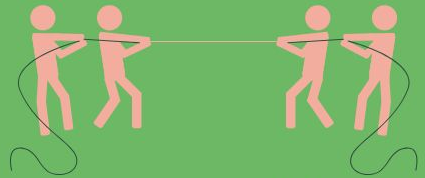
is influenced directly by other people (e.g., family, friends) and settings (e.g., schools, neighborhoods) and indirectly by their environment and culture;

and shapes and influences her environment and narrative via connections with other learners, community representatives, and the broader scope of world culture.



THE GIRL LEARNER

A girl's *History-In-Person*



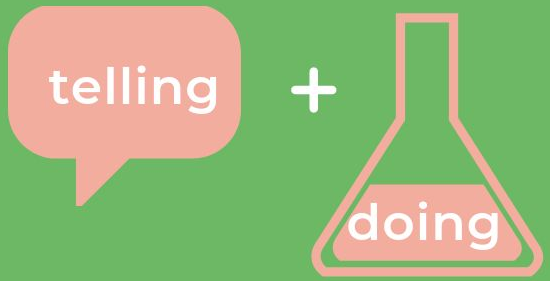
historical personal struggle + historical insitutional struggle

forms

her *Identities-In-Practice*.

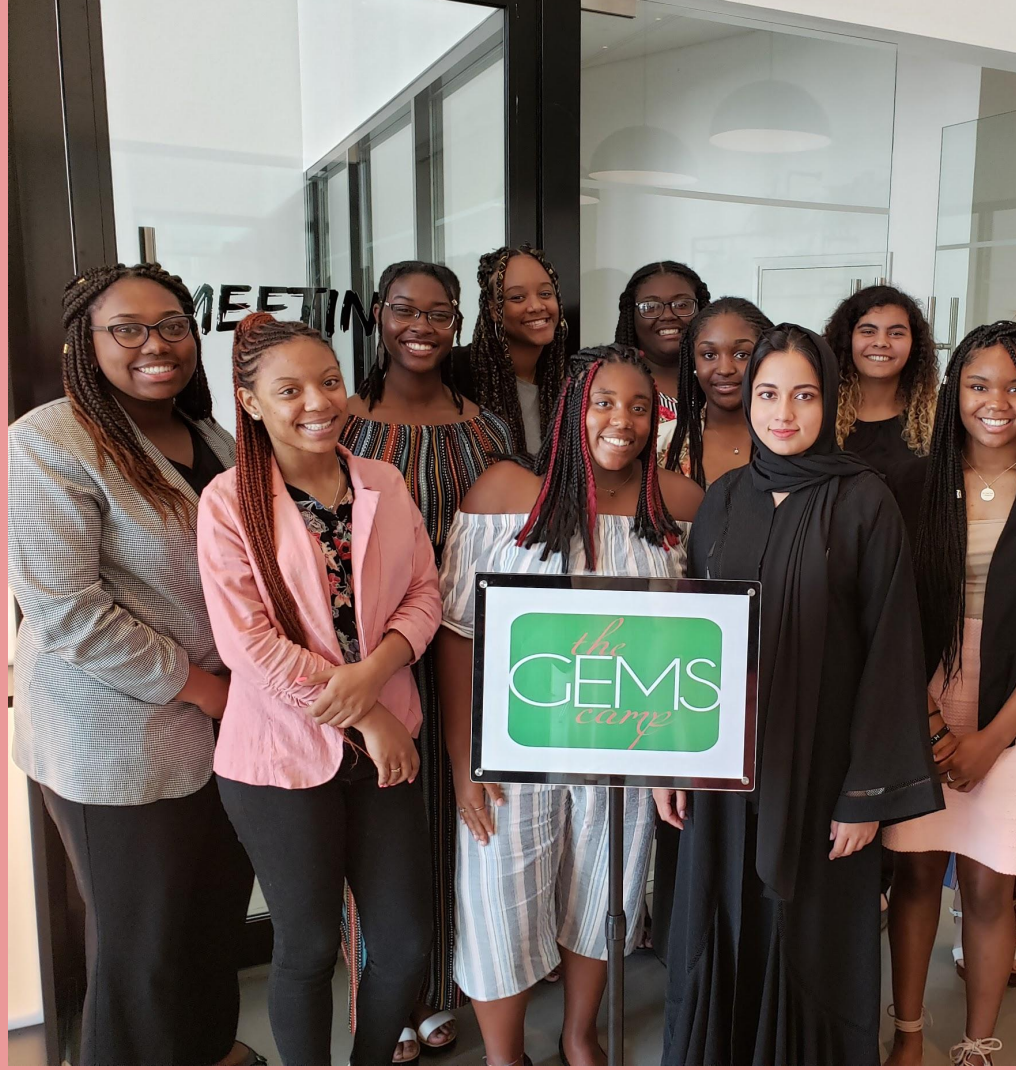
NARRATIVE IDENTITY-IN-PRACTICE

EMBODIED IDENTITY-IN-PRACTICE



SOURCE: ATAN, E., CALABRESE BARTON, A., KANG, H. AND O'NEILL, T. (2013).

University interest in Informal Learning for Girls of Color in STEM

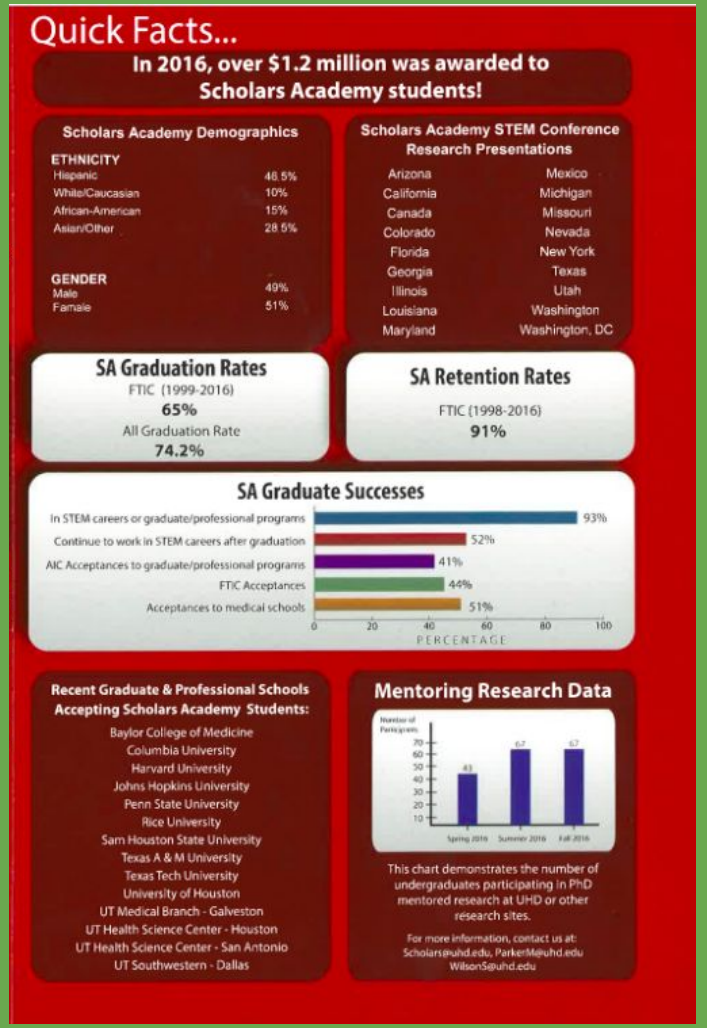


University of Houston-Downtown

- Located in downtown Houston
- 20:1 student-to-faculty ratio
- One of lowest tuition rates among state college and universities
- Student Population:
  - 20% African-American
  - 51% LatinX
- Age Ranges: 25-30 (25%)
- 50% of students work full-time

Current STEM Efforts at UHD: *Scholar's Academy*

- Smaller classes, faculty mentoring, modern labs, hands-on experience and flexible course options.
- Participate in special extracurricular activities, research internships, community service and STEM-related seminars/field trips.
- Each student is awarded a scholarship on average of $3,000 - $4,000 per academic year. Summer stipends are also granted for research participation.
- Academy members may apply and receive additional financial assistance, such as the TEXAS grant and Hispanic Scholarship Fund.



Current STEM Efforts at UHD: *Noyce Mathematics Teacher Scholarship Program*

- NSF/Noyce Funded Scholarship Program
- Provides $12,000 per year for BA in Mathematics with Secondary Teacher Certification
- Must teach for 4 years in a high-needs district
- Teacher education program is specifically targeted to prepare students for urban schools
- Currently 30+ scholarships have been awarded with 20+ current secondary mathematics teachers in Houston-area and El Paso.
- Increased secondary mathematics preservice teacher population from 0% to 40% of current mathematics majors over 9 years.

Current STEM Efforts at UHD:
New CST Building

14 Lab classrooms
14 Research labs

Current STEM Efforts at UHD: *Undergraduate Research*

- NSF-funded REU Programs
- Required Senior Research Projects
- Internships
- Annual Student Research Conference

What concerns me as a higher education STEM faculty member....

1. Developmental Mathematics Courses

- 40% of 4-year college students enter college needing developmental mathematics coursework and many do not end up passing these courses.
- Despite the creation of alternative mathematics courses (Statistical Literacy and Contemporary Mathematics (previously Mathematics for Liberal Arts)
  College Algebra remains a requirement for STEM majors.
- “During their first year in college, 40 percent of bachelor’s degree students did not take mathematics; 9 percent took only precollege-level math courses; 30 percent took introductory college-level but no higher-level mathematics;” STEM persistence correlates with taking upper-level mathematics (Calculus 1) (Chen, 2013)

Most STEM Degree Plans Start with Calculus 1

Results from Math 0300, Fall 2018

- Surveyed all 25 students and conducted follow-up interviews with four.
- Mostly Latina, first-time in college, pre-NS majors
- Most had taken beyond Algebra 2 in HS and earned a passing grade.
- Most attributed low TSI score to not understanding algebra which they attributed to one particular experience in mathematic with a teacher.
- All felt that they would be able to be successful in the NS major despite the setback in mathematics.

Co-Enrollment Model via THB 2223

- Requires each IHE to develop and implement for developmental coursework a corequisite model for 75% of students enrolled in DE for readings/writing/math
- 8-week Developmental Math/8-week College Credit Math Model at UHD

2. Failure Rates in College Algebra

- At UHD, around 40% D,F,W for students taking College Algebra despite the fact that content is actually easier than most high school algebra 2 courses.
- The course is very symbolically-driven and different from HS mathematics especially with respect to use of graphing calculators, the role of traditional exams, and pace of the course.

3. Reliance on Traditional Pedagogy in Mathematics in Higher Ed

- Despite what we know from research about the benefits of inquiry-based instruction, undergraduate mathematics course are still being taught using traditional methods.
- Pedagogies such as CRP and CRT are largely missing from HSI and MSI where they are needed.
- Being “naturally good at math” is an idea that still persists.

Culturally Relevant Pedagogy in STEM Education

“But That’s Just Good Teaching!” by Gloria Ladson-Billings (1995)

- Studied effective teachers of African-American teachers to look for pedagogical practices that went beyond just “good teaching” and called them culturally relevant teaching practices. These practices forefronted:
  - *Academic Excellence*
  - *Cultural Competence*
  - *Critical Consciousness*
- CRP in action looks like:
  - *Equitable relationships between teachers and students based on “care”*
  - *Critical stance towards curriculum and standards to work in best interest of their students*
  - *Approached teaching as an art and themselves as m*asters of artistry

CRP in Science

- Encouraging explanations and solutions from students
- Equitable classrooms characterized by respect and “care”
- Assessment based on demonstrating competence
- Encouraging critiques and expansions of traditional Western science
- Using science for developing sociopolitical consciousness

(Brown, 2017)

CRP in Mathematics

Teachers demonstrated:

- Relationships categorized by “care”
- Knowledge of and pedagogical use of students’ context (neighborhood, lives, etc.)
- Knowledge of and pedagogical use of cultural competence
- High expectations of students
- Inquiry-based, student-centered mathematical instruction

(Thomas and Berry 2019)

The Dangers of Informal Learning without CRP

From “Advancing alternate tools: why science education needs

CRP and CRT “ by Vanessa Dodo Seriki (2016)

From “Ad
CRP and (

Table 1 Constituent assumptions and actions

Constituents	Assumption	Action
Community sponsor	Deficit orientation toward the Achievement Scholars (e.g., Achievement Scholars lacked the knowledge and skills to engage in the mural project)	Required a local art expert to work with the AAP on the mural project
Jacob (local expert)	Deficit orientation toward the Achievement Scholars Relationship building would occur with little to no effort	Ignored the ideas that the Achievement Scholars generated on their own Expressed no interest in getting to know the Achievement Scholars Used coded language as a means to build relationships (Dixson and Dodo Seriki 2014)
Ridgeway and Yerrick	Achievement Scholars possessed an array of knowledge, skills, and interests that would be useful in the design and creation of the mural Jacob would want to get to know the Achievement Scholars Jacob knew how to engage students in culturally relevant ways Jacob understood culturally relevant pedagogy	Filled the gaps left by the local art expert (Jacob)

Remind Ourselves.....

- Who is this work for?
- What assumptions about our students are we bringing with us?
- Are our partners (community, business, university, etc.) operating based on harmful assumptions?
- Are we listening to the need of the students?

Brainstorming Framework Strategies for Informal and Formal STEM Learning

Activity: Brainstorming a Framework

1. Think about the girl students that you serve.
   - What are their risk factors?
   - What are some protective factors?
   - What might be some historical personal struggles? Historical institutional struggles?
2. What is your goal for those girls?
3. What is their journey like to/from school?
   - Attitudes
   - Interactions
   - Feelings
4. What would make the girls' math and science experience unique?
   - Who needs to be involved (stakeholders)?
   - What learning opportunities exists for girls to use science or mathematics to develop critical consciousness?
5. What does your data tell you collectively about the girls?
6. What time frame are you considering? Afterschool? Summer? 1-week?
7. What resources do you need?

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STEM LEARNING
ECOSYSTEM

GIRL AT THE CENTER

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A girl's *History-In-Person*

historical personal struggle + historical insitutional struggle

forms

her *Identities-In-Practice.*

NARRATIVE IDENTITY-IN-PRACTICE

EMBODIED IDENTITY-IN-PRACTICE

SOURCE: ATAN, E., CALABRESE BARTON, A., KANG, H. AND O'NEILL, T. (2013).

RISK FACTORS
GEMS addresses the following

INDIVIDUAL FACTORS
- Lack of self-confidence
- Poor-self image
- Loss of significance
- Victims of bullying or harassment
- Increased exposure to high-risk social behavior

FAMILY FACTORS
- High family mobility
- Low education level of parents
- Large number of siblings
- Not living with both natural parents
- Family disruption
- Sibling(s) has dropped out
- Low contact/involvement with school

SCHOOL FACTORS
- School size: too large
- Class size: too large
- Math & reading low-achievement levels
- Majority of students read below grade level
- Poor student engagement
- Inexperienced math/science teachers
- Lack of access to technology

COMMUNITY FACTORS
- Family socioeconomic status
- Local labor market & neighborhood stability
- Youth social attitudes
- Community violence
- Lack of STEM academic and career role models

PROTECTIVE FACTORS
GEMS promotes the following

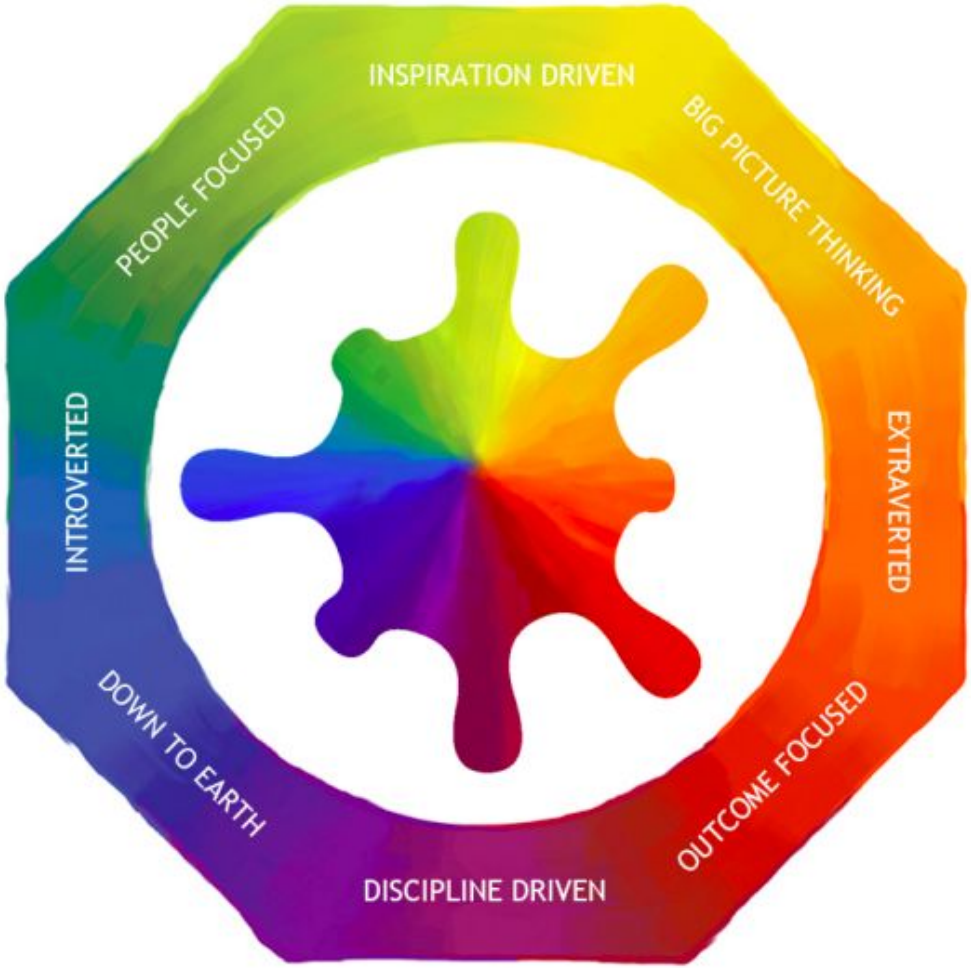
RELATIONSHIPS
- Provide opportunities for social involvement
- Clear social norms
- Develop good relationships with adults and peers
- Involved in positive summer and extra-curricular activities

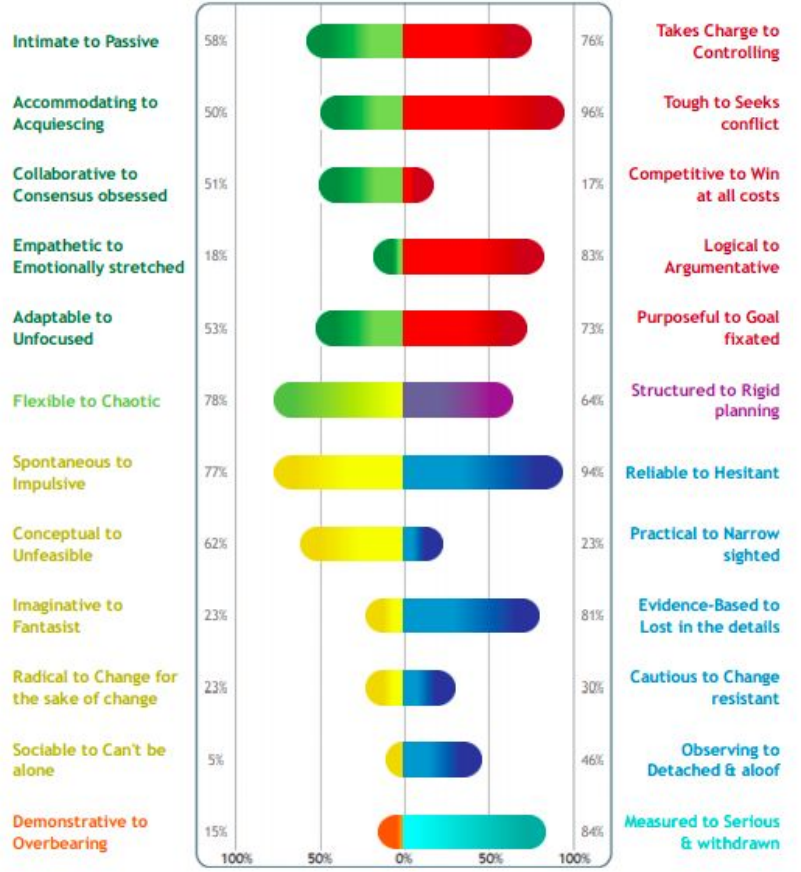
INDEPENDENCE
- Foster in each student the love of learning STEM
- Promote positive & resilient temperament
- Instill a sense of social responsibility
- Develop qualities of leadership to serve and advocate
- See a future that requires imagination & hard work
- Generate resiliency in the face of adversity

COMPETENCE
- Treat each girl as a gifted learner
- Promote active decision-making
- Learn to identify problems or areas for improvement
- Think critically and solve challenging problems
- Communicate and collaborate
- Develop skills to compete in the global economy
- Adapt to change

CREATIVITY
- Learn problem-solving skills and how to apply the engineering design process
- Learn the value of flexibility
- Engage in complex conversations
- Apply academics to meet real-world challenges

Saki Milton, MBA - Your Spark Mandala





Lumina Spark Portrait

Review of Learning Outcomes

- To explore how STEM learning ecosystems can support girls
- To gain a an understanding of culturally relevant pedagogy
- To brainstorm framework strategies for formal and informal settings

Thank you.

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