Connecting STEM Learning to the Community

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Incorporating Neighborhood and Community Elements into STEM Curriculum

Innovative pedagogical strategies that reach all students
Near West-side Full Service Community School Engagement

- Community STEM Partners
- Community Education Taskforce
- Teachers and Students
Rational for STEM Education

• Across the United States, growth in traditional STEM Fields are expected to be the fastest-growing employment sectors.

• Current education systems are not producing enough STEM-capable students to keep up with traditional STEM-capable sectors or new or innovative skills.

• All students must have a solid foundation in STEM education; be it engaging in health care, understanding environmental stewardship, understanding current geopolitics, or explaining global opportunities and crises.

• Maintaining scientific and technological leadership is essential to our economy, national security, and the future of this country.
Why STEM and Community Engagement?

- Engages students in their communities
- Real world STEM education for all students
- Empowers teachers to reach all students
- Supports community engagement
- Becomes a part of community visioning and workforce needs
Program Goals

• **Equitable:** Make STEM literacy and economic opportunity attainable for all students.

• **Scalable & Sustainable:** Drive educational innovation and economic alignment in a coordinated and methodical way.

• **Innovative:** Give teachers the tools for transformative changes to STEM education

• **STEM-Focused:** Empower and support a culture that nurtures and supports innovative STEM professionals, and brings university, businesses, schools, nonprofits, and other community institutions together to prepare students and communities for 21st century jobs.

• **Collaborative:** Develop a network for STEM excellence and evidence-based research
Knowledge Building

- Peers
- STEM Content
- Teachers
- Academic Performance
- Pedagogy
- Students
- Social Media
- Community
- Home
Incorporating Urban School and Community Elements into STEM Curriculum

KEY ELEMENTS
• Culture
• Congruence
• Community
• Collaboration
Student Center Teaching

1. Transfer **control** of the learning process to the students
2. Foster **inquisitiveness** in students
3. Increase **collaboration** among students
4. Provide hands-on, **experiential learning**
5. Know your student’s **culture(s)**
6. Learn in the **community and the resources available**
Rethinking the Way We Learn: Innovative Pedagogies to Teaching STEM

• Universal Design
• Backwards Design
• Pedagogies aligned with special education, English language learners
• Content specific pedagogy for effective teaching
• Culturally Responsive Education
Center for Research on Educational Diversity & Excellence (CREDE)

- Teachers enacting to reach all students
- Focuses on the integration of all students
- Activity centers
  1. Joint Productive Activity
  2. Language and Literacy Development
  3. Contextualization
  4. Challenging Activity
  5. Instructional Conversation

McGranier & Saenz (2009) Preparing Teachers of English Language Learners, National Comprehensive Center for Teacher Quality
Center 1: Joint Productive Activity (JPA): Teachers and students producing together

1. Teachers participate with students in joint productive activity.

2. Students are grouped in a variety of groupings such as by friendship, mixed academic ability, language, project, interests, etc. to promote interaction.

3. Students work in groups and move from one activity to another such as from large group introduction to small group activity, for clean-up, dismissal, etc.
Center II: Developing Language and Literacy Across the Curriculum (LLD)

1. Encourages students’ use of first and second languages in instructional activities
2. Listens to student talk about familiar topics
3. Assists language and literacy through modeling, eliciting, probing, restating, clarifying, questioning, and affirming
4. Encourages students to use content vocabulary to express their understanding
Center III: Making Meaning: Connecting School to Student's Lives (MM)

1. Begins activities based on what students already know from home, community, and school.
2. Designs instructional activities that are meaningful to students in terms of local community norms and knowledge.
3. Acquires knowledge of local norms and knowledge by talking to students, parents, community members, and by reading pertinent documents.
4. Plans jointly with students to design community-based learning activities.
5. Varies activities according to students' preferences, from collective and cooperative to individual and competitive.
Center IV: Teaching Complex Thinking: Cognitive Challenge (CC)

1. Insures that students, for each instructional topic, see the whole picture as the basis for understanding the parts.
3. Designs instructional tasks that advance student understanding to more complex levels.
4. Assists students to accomplish more complex understanding by relating to their real-life experience and what they consider to be controversial issues.
Center V: Teaching Through Instructional Conversation (IC)

1. Arranges the classroom to accommodate conversation between the teacher and small groups of students on a regular and frequent schedule.
2. Ensures that a clear academic goal guides conversation.
3. Guides conversation to include students' views, judgments and rationales, based on text evidence and other substantive support.
4. Ensures that all students are included in the conversation.
5. Listens carefully to assess levels of student understanding.
6. Assists student learning throughout the conversation by questioning, restating, praising, encouraging, etc.
Center VI - Critical Stance (CC)

1. Activities encourage the application of school learning to the real world, context, problems, or injustices.
2. Teachers consciously engage students in naming experiences, reflecting upon them and, taking action within their sphere of influence.
3. Students are taught to think critically about STEM concepts and how they relate to social justice education.
Content Specific Application
Science

- Students use scientific principles to analyze and address social injustices such as local water pollution (Dimick, 2012).
- Students make connections between traditional cultural practices, such as arrow making and throwing, and science content, such as accelerated motion (Grimberg & Gummer, 2013).
- Students explicitly identify how their linguistic and cultural experiences and values relate to those of science via instructional congruence (Lee & Fradd, 1998). For instance, they may discuss how the validity of knowledge claims varies from context to context (Lee & Buxton, 2013).
Technology and Engineering

• Students learn from elderly adults in their communities. Students question adults about traditional ways of designing solutions to local problems, and students use new or traditional tools and approaches to develop solutions to similar problems (Kern, Howard, Brasch, Fiedler, & Cadwell, 2015).

• Students draw from their community cultural wealth, including the desire to help their communities with problems and work with adults who can promote technology and engineering programs (Samuelson & Litzler, 2016).

• Students create robots to address a community problem such as dusk to dawn lighting for certain parks or streets.
Mathematics

• Encourage students solve mathematical problems that are connected to their lives and their communities including the timing of street stop lights during certain times of the day, sport statistics (Ensign, 2003; Razfar, 2012).

• Students participate in collaborative family projects with a focus on real-life applications, such as construction work (Civil, 2002) or gardening (Civil & Khan, 2001).

• Students use mathematical analyses to examine societal inequalities, such as racial profiling during traffic stops, student graduation rates (Gutstein, 2003).
Motivating Students to Question

• Provide tangible examples in which science is used that affects the students’ communities in an intimate way.

• The question/problem should focus on what is important to the students and what brings out their passion.

• Teachers can help students learn this material to answer real-world problems, give them some concrete real-world problems that have been addressed in the past (even if answers are just partial), and give them reasons to want to study this material and topic.
Culture + skills+ experience = ENGAGEMENT

Engaging students in meaningful activities that incorporate their own culture, skills, experiences and prior learning, allows students to make connections that inspire and engage them in STEM.
Culturally Responsive Teaching & Culturally Relevant Teaching

• **Culturally responsive teaching** (CRT) is defined as a *pedagogy that recognizes, respects, and uses cultural characteristics, experiences, and perspectives of ethnically diverse students and backgrounds as meaningful sources for creating optimal learning environments and teaching them more effectively* (Ladson-Billings, 1994, 2014; Nieto 2000; Gay 2000, 2002).

• Ladson-Billings (2009) defines **culturally relevant teaching** as a “*pedagogy that empowers students intellectually, socially, emotionally, and politically by using cultural referents to impart knowledge, skills, and attitudes*” (p.20).
Culturally Responsive Teaching
A New Mindset

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Background

NCHS

- Located on the northside of Indy
- 3800+ students
- Highly diverse
- 51% free and reduced lunch
- 90% graduation rate

Enrollment 2016-17 by Ethnicity

- American Indian
- Hispanic
- Multiracial
- Native Hawaiian or Other Pacific Islander
- Black
- White
- Asian
Challenge

Students beliefs about science...

➔ It's hard
➔ I won't ever use it
➔ I'm not good at it
➔ It's boring
Let's change the way we teach curriculum and ENGAGE students in learning.
"Culturally relevant teaching requires that students maintain some cultural integrity as well as academic excellence." - Ladson-Billings
Examples

➔ **Scientist Like Me**
  Students research a scientist that has ethnicity, race, or religion in common with them. Students must also give information about themselves.

➔ **Engagement**: Research to find a scientist like them.

➔ **Standards**: Scientific disciplines
Examples

➔ **Stem Cell Debate**
   Students research stem cells and then decide and debate how they should be used.

➔ **Engagement:** Would you clone yourself? Why or why not?

➔ **Standards:** Ethics in Science
Examples

➔ **Superhero Creation:** Students create fictional characters that have super powers due to chromosomal mutations.

➔ **Engagement:** If you could have a superpower what would it be? (Also watch X-men)

➔ **Standards:** B4.1 and B4.5
COMMUNITY

“Giving students opportunities to tackle real-world problems is a surefire strategy to increase engagement.”
-Suzie Boss (Edutopia)
Examples

➔ **Meat and Me**
Students research the sources of meat in local supermarkets. They then will present their findings to their community.

➔ **Engagement:** A local farmer and an animal activist come give presentations on how big farms benefit and harm the environment.

➔ **Standards:** B3.1, B3.2 and B3.3
Examples

➔ Cells, Disease, and Me

Students research how mutations in cells change proteins and create diseases. Students also look at why certain diseases affect specific populations of people more often.

➔ Engagement: A doctor speaks with students on why some diseases occur more often in certain ethnicities.

➔ Standards: B4.2
What students are saying...

“The guest speaker gave me some things to think about when eating meat.”
-Jackson

“This is the first time I have liked a science class!”
-Ryan

“Biology is hard, but Mrs. Brand makes it interesting.”
-Deyonna
Good luck!

I hope you’ll use these tips to go out and create memorable lessons for your students!

- http://www.ethicalchoicesprogram.org/
Informal Science Education

Contributory - Collaborative – Project-based Project
Informal Science Education (ISE)

**Definition**

*Is lifelong learning in science, technology, engineering, and math (STEM) that takes place across a multitude of designed settings and experiences outside of the formal classroom.*

[https://www.informalscience.org/](https://www.informalscience.org/)

**Examples**

- Field Trips
- Integrating Arts and Humanities in STEM
- Public Perception of Wildlife and Conservation
- Making Meaning Movement
Informal Science Education (ISE)

Programs are hosted by science centers, museums, community-based organizations.

Programs improve youth’s attitude about science, science literacy and academic achievement, positively influence youth’s critical thinking skills and behaviors, technology and study skills, classroom behavior, and academic pursuits and career goals (Bell, 2009; Biricini, Konur, 2011; NRC, 2009).
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