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STEM Problem-Based Learning for a Diverse Classroom of Learners

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Welcome to STEM Problem-Based Learning for a Diverse Classroom of Learners

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Agenda Overview

1. Problem Based Learning (PBL) to facilitate culturally relevant teaching

2. Creating culturally relevant STEM education
    - PBL activity and discussion: What's Bugging You

3. STEM Innovator® Portfolio to capture PBL competencies

4. STEM Innovator® professional development opportunities

5. Questions

What is Problem Based Learning?

Share your thoughts and experiences!

What is Problem Based Learning?

Problem-based learning (PBL) is a student-centered approach in which students learn about a subject by working in groups to solve an open-ended problem. This problem is what drives the motivation and the learning.

"Problem-Based Learning: Center for Teaching Innovation." *Problem-Based Learning | Center for Teaching Innovation*, Cornell University, 2021.

STEM Innovator Problem-Based Learning (PBL)

- ➔ Interdisciplinary approach to learning where student teams create sustainable prototype solutions to solve a real-world problem by employing feedback/data from diverse community members.
- ➔ Engages students in academic concepts and professional skills, practices, concepts and mindsets.
- ➔ Accomplished in contexts that make cultural connections between student interests, school, community, work, and the global enterprise enabling ALL to compete in the modern economy.

- Flynn, 2013 **revised** from Tsupros, 2009

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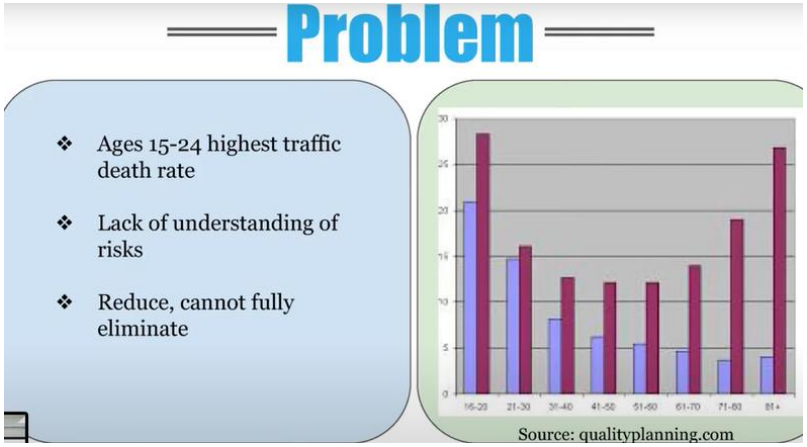
STEM Innovator® PBL Approach



What's Bugging You?

Discovery, Collaboration, & Communication

in the STEM Innovation Process

- *Engage students in cultural, individual, and place-based identities*
- *Utilization of empathy to identify problems worth solving & developing sustainable solutions*

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What do you think could be improved?

What really frustrates you in this world?

What is something that is always breaking or not working properly for you?

How would you design an existing product better?

Do you have an idea of a way to improve someone's life?

Do you wish something existed that currently doesn't?

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Let’s call those things BUGS!

Identifying bugs, or real-world problems, is just the first step of the innovation process…

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What is STEM Innovation?

- The focus is on **identifying real-world problems** occurring in your life and the community.

- The STEM Innovation Process will guide you through:
  - Identifying problems
  - Understanding the value in solving them
  - Creating meaningful solutions to improve other's lives

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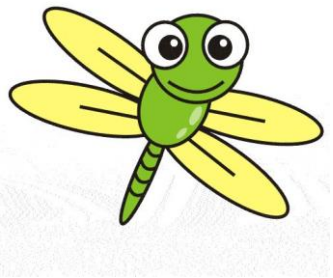

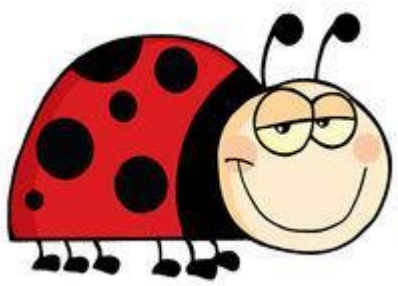

PART I

DISCOVERY PHASE

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The STEM Innovation Process

The Discovery Phase (Part 1)

- PROBLEM IDENTIFICATION: identify real-world problems
- VALUE: recognize worth of solving problems

The Validation Phase (Part 2)

- EMPATHIZE: verify the value of solving problems with others
- CUSTOMER DISCOVERY(Data): find out the communities' ideas on the problem, value, and possible solutions

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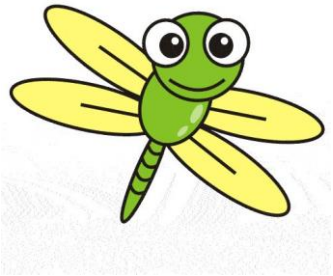
Problem Identification

Use the following prompts to consider possible problems:

- I wish I could…
- It annoys me when…
- It bugs me that…



Examples

- *It annoys me when I find gum on the bottom of my desk.*
- *I wish drivers were more attentive when I bicycle on busy roads.*

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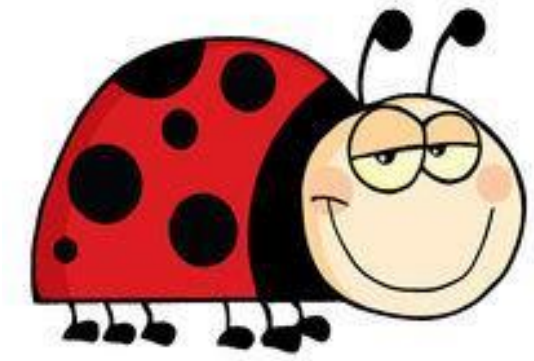
Why are your problems worth solving?



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Value Statements

Value is the importance, worth, merit, or usefulness of something.

Examples of value include:

- Societal Benefits
- Accessibility
- Convenience
- Usability
- Scientific Advancement
- Risk Reduction
- Design
- Time Saver
- Aesthetic Appeal
- Health/Wellness
- Special Features
- Customization
- Newness
- Cost Reduction
- Performance
- Brand or Status

Examples

Problem Identification	Value Statements
Example 1: My COVID face mask makes my glasses fog up	*Risk Reduction:* reduce the risk of COVID if mask can stay on while working *Time Saver:* less interrupted work time if not having to stop to dry off glasses
Example 2: Iowa rivers and lakes have unsafe contaminants from farming practices	*Health benefits*: Iowa water reservoirs will be safer to drink and use recreationally *Environmental benefits:* Improved conditions for Iowa wildlife and other areas impacted by our water systems downstream

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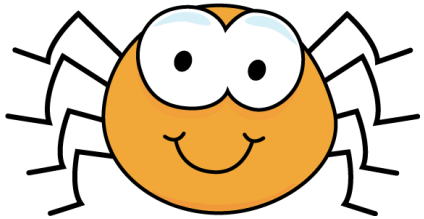
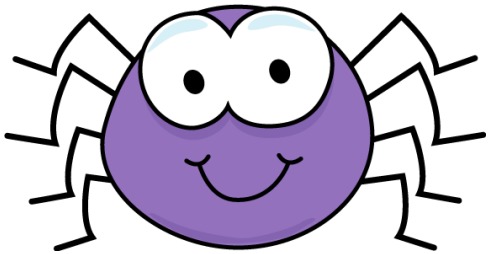


Generate 5 bugs in Table 1! <u>Don't</u> think about solutions at this point! (3 minutes)



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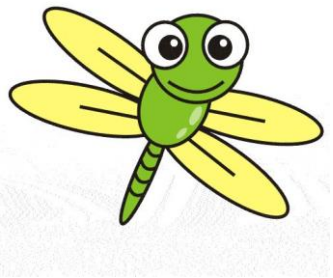

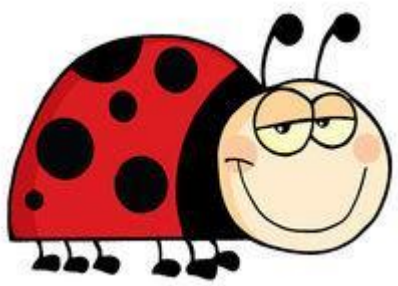

PART II

VALIDATION

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How might we determine if our ideas have real value?

Empathy helps you find Value by understanding what your potential audience wants, needs, and struggles in their daily life!

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Empathy

Empathy is the ability to understand, identify, and attend to the needs and wants of others.

Skills for gaining empathy include:

- Active Listening
- Recording Ideas
- Providing Feedback

You will now **interview others** to explore your chosen problem and find out more about their perspectives.

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Customer Discovery Interviews Set Up

1. First take a moment to choose ONE problem from your Table 1 list you would like to investigate further.
2. At the top of the Customer Discovery Interview Log, record the problem you are investigating into a problem statement.

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Customer Discovery Interview Questions

Customer Discovery Interview Log

Interviewer Name: _____ Problem: _____

Purpose: To capture customer's feedback on a problem, the value in solving the problem, and ideas for a solution				
Who is the customer? • Name? • Role? (community member, teacher, student, etc.) • Age range? • Date of the interview?	**Does the customer have the problem?** • The problem we are trying to solve is _____ • Do you have this problem? When? Why or why not? • Tell me more about this problem.	**Who else does the customer think has the problem?** • Who else do you think has the problem? • Describe the person (age, role, etc.) • What problem do they have?	**What value does the customer see in solving the problem?** • What value is there in solving the problem?	**What is a suggestion for a solution?** • What solution do you have for solving the problem? Why? • What solutions already exist? Do you like these? Why or why not?
1)				

Customer Discovery Interviews: Round 1

1. Find a partner and decide who will ask the interview questions first.
2. **Five minutes** for partner 1 to interview partner 2.
    a. Use the interview prompts provided in the interview log.
    b. Be sure to DIG DEEPER with the follow-up questions provided.

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Customer Discovery Interviews: Round 2

Five minutes for partner 2 to interview partner 1.

a. Use the interview prompts provided in the interview log.
b. Be sure to DIG DEEPER with the follow-up questions provided.

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Customer Discovery Interviews: Analyze Your Results

1. How has your idea about your problem changed after interviewing others?
2. Did your proposed value of solving the problem match others?
3. How has your idea(s) about possible solutions changed after interviewing others?

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Connecting to Standards

Example: What's Bugging you Activity

NGSS

Practices of Science

- Ask and define problems
- Argue from evidence
- Communication

Cross Cutting Concepts

- Patterns

Disciplinary Core Ideas

- Multiple, based on project

Social-Emotional Learning

- Adaptable
- Collaborator
- Communicator
- Confidence
- Creative Thinker
- Empathy
- Executor
- Facilitator
- Grit
- Influencer
- Investigator
- Motivation
- Leadership
- Learner
- Responsible
- Tactical

Iowa 21st Century Skills

Employability Skills

- Cultural Communication
- Adaptability
- Initiative

Technology Standards (ISTS)

- **Empowered Learner**
  - Build networks
  - Feedback on learning
- **Knowledge Constructor**
  - Research strategies
- **Innovative Designer**
  - Design process
  - Open ended problems
  - Perseverance

Customer Discovery Interviews: Reflection

1. How does this process compare to what you are already doing in problem-based learning?

2. What are your thoughts about how students would react to this process?

3. How does this activity attend to culturally relevant STEM instruction?

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Possible PBL Next Steps…

1. Students pitch their problem in small groups or to the whole class.
2. Educators create a class list of potential problems. Students vote on top problem(s) to tackle.
3. Students take the *STEM Innovator® Profile* to assess the strengths they bring to a team
4. Educators use the individual strength data to build diverse teams.

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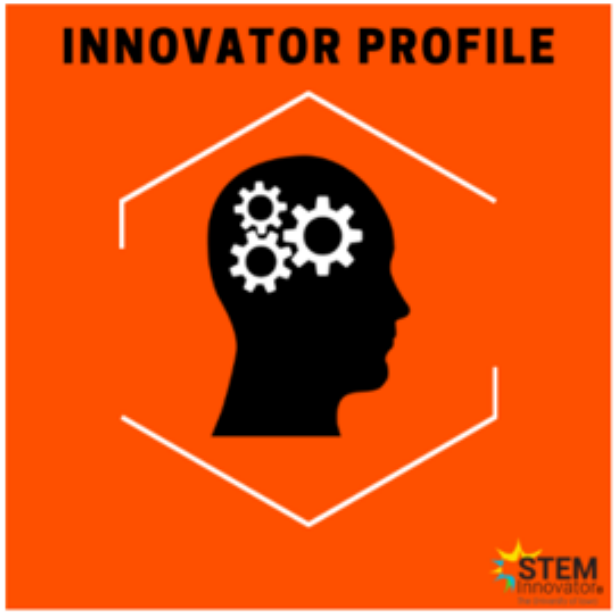
STEM Innovator® - Innovator Profile to Explore Strengths

INNOVATOR PROFILE: Capturing innovation & entrepreneurial skills and mindsets over time

SKILLS AND MINDSETS:

- ❑ Adaptable
- ❑ Collaborator
- ❑ Communicator
- ❑ Confidence
- ❑ Creative Thinker
- ❑ Empathy
- ❑ Executor
- ❑ Facilitator
- ❑ Skills to succeed in STEM
- ❑ Grit
- ❑ Influencer
- ❑ Investigator
- ❑ Motivation
- ❑ Leadership
- ❑ Learner
- ❑ Responsible
- ❑ Tactical
- ❑ Career interest in STEM



STEM Innovator® Portfolio: Innovator Profile

1. I am good at presenting ideas in front of an audience.

Rating:

65

Not at all like me | Not much like me | Somewhat unlike me | Somewhat like me | Much like me | Very much like me

0 10 20 30 40 50 60 70 80 90 100

In my mock trial class, I take the time to be prepared but am so nervous I tend to want to read off my notecards. I know I need to work at being more polished and confident while speaking in front of large groups.

Next

Innovator Profile Results

Student: Sample Student

Assignment: Innovator Profile #1

1. **Facilitator**

   You strive to help others succeed and enjoy helping others see their full potential. You find the positive attributes in others.

Score	Reasoning
99	Helping others see their own potential and helping them find success is why I became an educator. I had great teachers myself and recognized how powerful these role models were in my own life. I enjoy having students explore their strengths and discussing how it can help them in their personal and professional lives.

2. **Learner**

   You are someone who really loves to learn, search and read about new things. The passion to acquire new knowledge.

Score	Reasoning
99	I have three advanced degrees and have always enjoyed new learning.

3. **Leader**

   Creates an inspiring vision of the future. Motivates and inspires people to engage with that vision. Enjoyment in the task of taking charge and assigning roles to people.

Score	Reasoning
98	I tend to be the group member who keeps track of details and notes next steps. I recognize it's important that a group be organized and each person knows exactly what they should do for follow-up.

4. **Empathy**

   You listen to others. You understands a variety of perspectives. You understand the needs and challenges of others. People are valuable and deserve to be treated respectfully. People have different strengths and experiences. The best innovators are good listeners.

Score	Reasoning

STEM Innovator® Profile: Class Strengths To Build Innovation Teams

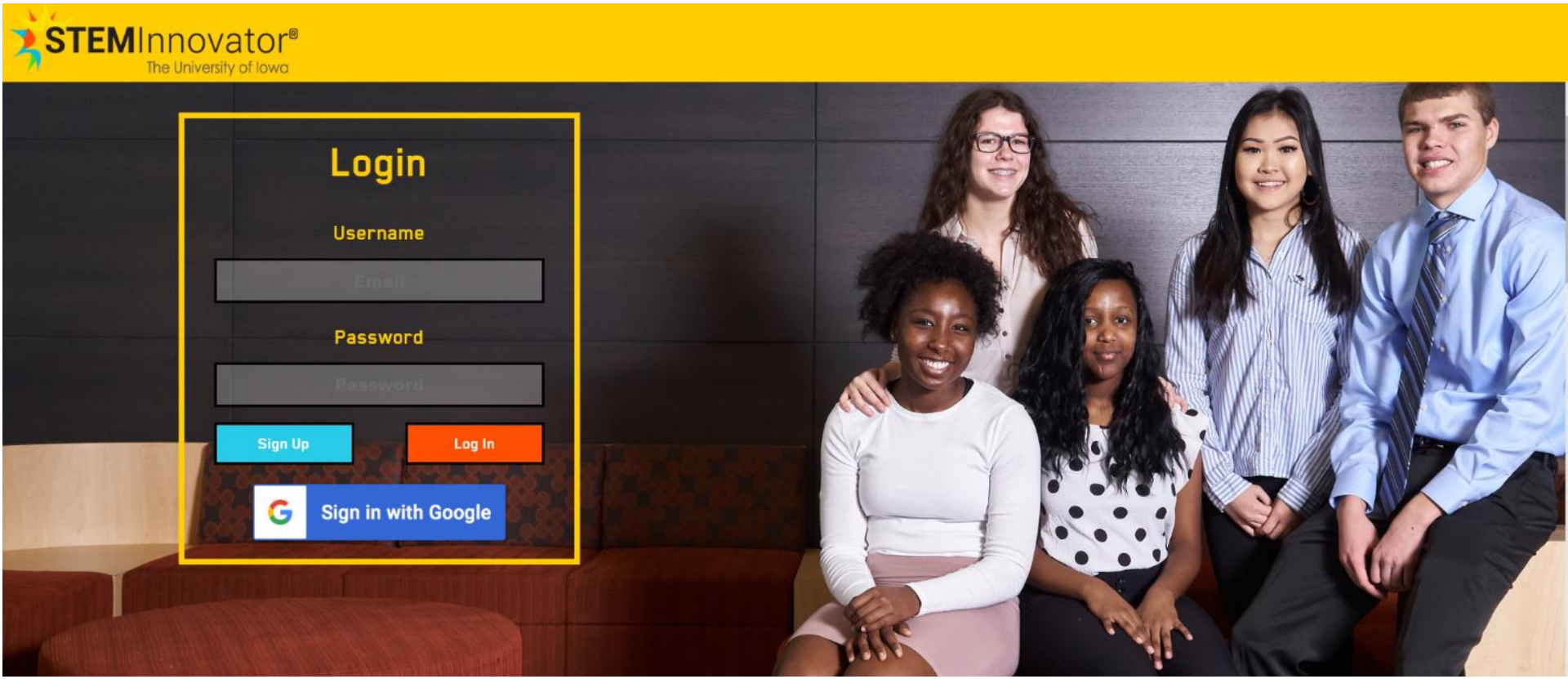
	Executing				Relationship Building				Strategic Thinking				Influencing				Talent	
Leadership Descriptions	Leaders know how to make things happen. When you need someone to implement a solution, these are the people who will work tirelessly to get it done. Leaders with a strength to execute have the ability to "catch" an idea and make it a reality.				Essential glue that holds a team together. Without these strengths on a team, in many cases, the group is simply a composite of individuals. In contrast, leaders with exceptional relationship building strength have the unique ability to create groups and organizations that are much greater than the sum of their parts.				Keep team focused on what could be. They are constantly absorbing and analyzing information and helping the team make better decisions. People with strength in this domain continually stretch our thinking for the future.				hose with strengths in this domain are always selling the team's ideas inside and outside of the organization. When you need someone to take charge, speak up, and make sure your group is heard, look to someone with the strength to influence.				Individuals who identify the skills and mindsets to suceed in an innovation driven economyand have an interest in pursuing problem solving as a career	
Skills & Mindsets	**Grit** Determination, Resilience, Tenacity	**Motivation** Ambition, Inspiration, Drive	**Responsibility** Accountability, Maturity, Trustworthy	**Execute** Accomplish, Perform, Do-er	**Adaptable** Versatile, Flexible, Adjustable	**Empathy** Compassion, Warmth, Insight	**Facilitator** Helper, Grower	**Collaborator** Teamwork, Harmony, Relator	**Investigator** Examiner, Analyst, Detective	**Creative Thinker** Imagmitive, Inventive, Visionary	**Learner** Improver, Scholar	**Tactical** Strategic, Calculated	**Leader** Commander, Director, Guide	**Communicator** Connector, Correspondent	**Confidence** Self-Assurance, Courage	**Influencer** Impact, Woo, Impress	**Skills to Succeed in STEM**	**Career Interest in STEM**
Aluminum, Andre	3		2								5	4						1
Calcium, Carlos		1							3				5				4	2
Helium, Henry	2		5			3							4		1			
Iodine, Imani		5	1									3	2			4		
Hydrogen, Heidi			2			3	1					5	4					
Neon, Nelly			4			2		1		3	5							

STEM Innovator® PBL Goals: What do students DO?

- Identify problems of interest to them and their community
- Develop empathy as they conduct interviews to explore the problem others have and their ideas for a solution
- Propose and refine sustainable prototype solutions using evidence to argue for a solution
- Engage with peers and business/industry experts throughout the process to get critical feedback
- Reflect on their individual and team efforts to recognize their own strengths, mindsets, and passions

Future Ready Creative Problem Solvers: How can you efficiently capture student PBL competencies?

STEM Innovator® Portfolio Tool for Capturing Student PBL Competencies AND Engagement of Community Members



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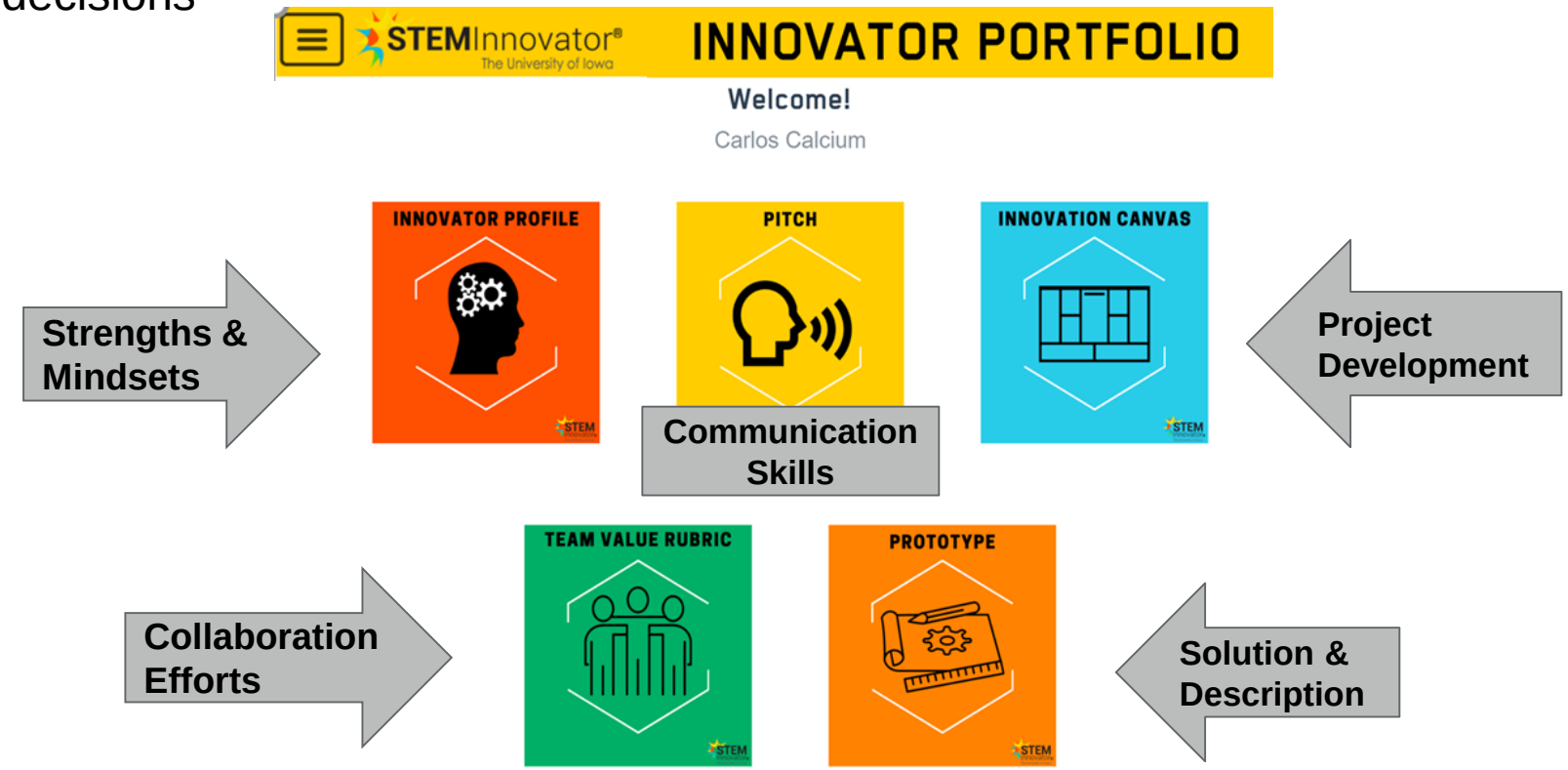
STEM Innovator® Portfolio Tool

Collect **Individual** and **Team** competency artifacts over time, receive feedback from peers and community partners, and use feedback to make data-driven decisions



Why a Portfolio? Why Now?

➢ ***Capture Student Competencies during Problem/Project-Based Learning***

- ***Future Ready:*** Profile of a Graduate as a creative problem solver
- ***Outdated Measures of Competencies:*** Current standardized tests do not capture skills, mindsets, practices, professional and academic knowledge of a future ready creative problem solver
- ***Nature of Science: Collaborative, Data-Driven, Argue from Evidence:*** Collaboration and actionable feedback from community, peers, educators.
- ***Higher Education:*** Portfolio as alternative for admission, scholarships

Want to find out more?

- ➔ We offer **5 online & self-paced workshops** that allow educators to experience the innovation process as a student would while learning about each Portfolio tool.
- ➔ NOTE: Educators who complete workshops 1-5 become STEM Innovator® certified. They can then have their high school students submit their Portfolio work for consideration of 3 University of Iowa college credits.
- ➔ Take our informational flyers about our online, self-paced workshops and Portfolio (and share with others!)

Professional Development: Online & Self-Paced Workshops

WORKSHOP 1

Introduction to STEM Innovation & Entrepreneurial Thinking

WORKSHOP 2

STEM Innovation

- Design Thinking
- Skills and Mindsets
- Prototyping

WORKSHOP 3

STEM Entrepreneurship

- Data-Driven Decision Making
- Project Management
- Entrepreneurial Practices

WORKSHOP 4

STEM Innovation Activities and Portfolio Assessment for the Classroom

WORKSHOP 5

Incorporation of STEM Innovator® Resources and Portfolio Tools to Create an Innovation Model for your Classroom

WORKSHOP 6

Creating a STEM Innovation Culture: A Deep Dive into Implementation Strategies

STEM Innovator® Certified Educators Only

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Professional Development: Online Options

- **Format & Investment**
  - Self-paced, online, asynchronous
  - Weekly collaborative sessions with colleagues and instructors (optional)
  - Cost: $79 per workshop
  - Optional graduate credit: $149 per credit

- **Earn Graduate Credit**
  - Perfect for license renewal and salary advancement
  - 1 graduate credit per workshop for workshops 1-5
  - Workshop 6 allows up to 3 graduate credits

Questions? Comments? Feedback?

You may also email stem-innovator@uiowa.edu with any questions, comments or feedback!