

Ohio

**STEM
Learning Network**

**Cleveland Regional Hub
Stem Professional Development
Institute**

Marcy Raymond, OSLN Principal in Residence



STEM is...

A highly personalized, intellectually vibrant learning community.

- Democratic
- Agile
- Responsible
- Collaborative



STEM Schools have...

CLARITY OF INTENT

- build system capacity, spread innovation, and serve the greater common good
- are meaningful and accountable to the partnerships and places that host the school
- bridge the gap between how we live and learn in the 21st century by blending formal schooling with cooperative learning, post secondary and informal education

- engage public / private partnerships
- align results-driven incentives for strong and sustainable partnerships
- hubs for P-16 stem education reform

GUIDING DESIGN PRINCIPLES

STEM Schools follow...



- Own their own potential
- Master their own path
- Make a difference
- Recognize that problems are sources for innovation
- Accept that it is each individual's responsibility to take on issues of sustainability

STEM Pedagogy

- Trans-disciplinary approach to content deployment
 - Math, Science, English, Art, Social Studies, Chinese
 - Capstone
- Framed by the Greater Cleveland Context
- Problem-Based
- Mastery Assessed



Structures and Strategies



Time vs Performance

Performance Measure		
A		
B		
C		
D		
F		
	Time	

In a “Traditional” Assessment System, Performance is variable while time is not.

In a “Mastery” Assessment System, Time is variable while Performance is not.

Partnership Oriented

- Content-rich Partnerships
- Academic Enrichment
- Community involvement
- Regional impact



Partnership Example

Regional Engineering Program Gateway

- Battelle provides engineering training to area teachers
- Metro extends opportunities to students beyond a single high school

STEM school...
... big footprint



Looking at STEM Work

Atlas Protocol

Inquiry by Classroom

Looking at Student Work
Atlas Protocol

Atlas Protocol

- Exploration – teacher determines the source for examination of student data
- Investigable Question – teacher asks colleagues for help on an essential question
- Experimental Design – use the looking at student work protocol
- Discoveries – teacher records his/her findings as the work progresses
- Dissemination – at the end of the protocol, the teacher debriefs their learning

*Defining
Inquiry*
**The Inquiry
Continuum**

- *Structured Inquiry*
- *Guided Inquiry*
- *Open Inquiry*

Defining Inquiry

The Inquiry Continuum

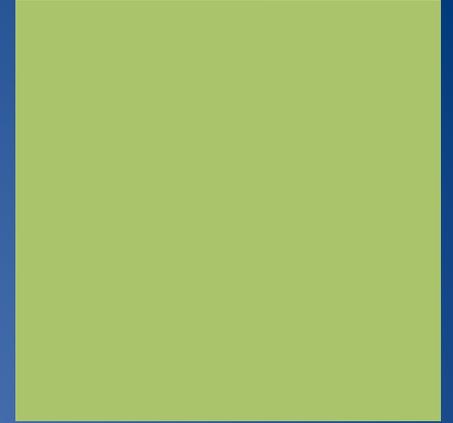
■ *Structured Inquiry*

- teacher provides learners with a hands-on problem to investigate, as well as procedures and materials, but does not inform them of expected outcomes.



Goals of Structured Inquiry

- Introduce concepts, vocabulary, processes, skills, and investigation methods
- Guide students toward specific discoveries
- Provide a common base of experiences



Defining Inquiry

The Inquiry Continuum

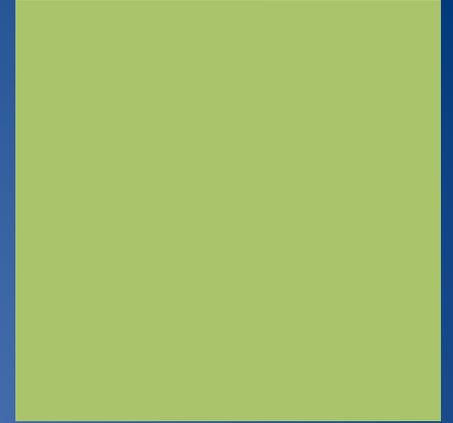
■ *Guided Inquiry*

- teacher provides only the materials and problem to investigate. Learners devise their own procedure to solve the problem.



Goals of Guided Inquiry Challenge/application

- Provide a sense of accomplishment
- Challenge students' conceptual understanding and skills by applying them to new situations
- Develop deeper and broader understanding through real world applications



Defining Inquiry

The Inquiry Continuum

■ *Open Inquiry*

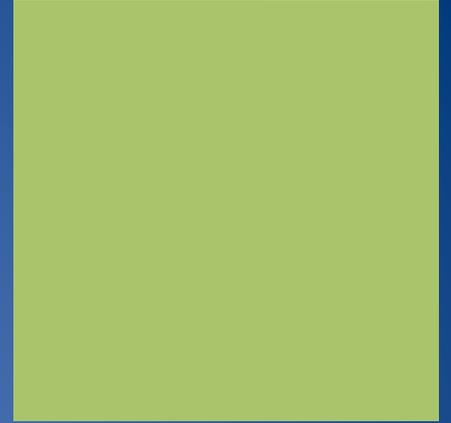
- learners formulate their own problem to investigate, as well as the procedure to solve the problem.

- *Alan Colburn, An Inquiry Primer*



Goals of Open Inquiry

- Generate questions
- Encourage students to work together without direct teacher instruction
- Develop and identify concepts, processes and skills, raise questions and problems



The Inquiry Continuum

	Demo	Structured Inquiry	Guided Inquiry	Open Inquiry
Question	<i>Teacher</i>	<i>Teacher</i>	<i>Teacher</i>	<i>Learner</i>
Procedure	<i>Teacher</i>	<i>Teacher</i>	<i>Learner</i>	<i>Learner</i>
Results	<i>Teacher</i>	<i>Learner</i>	<i>Learner</i>	<i>Learner</i>

- Douglas Llewellyn, *Inquire Within*

Questions generated can be:

*“investigable,”
“non-investigable,” or
“not sure”*

Questions

Investigable

- can be answered by something you can do in the classroom

Questions

Non-Investigable

- can not be answered by something you do firsthand in the classroom

Nouns

- Traditional teaching
- Standards based teaching
- Standards
- Understandings
- Essential questions
- Performance task
- Bloom's taxonomy

Adapted from: Wiggins, Stiggins, Ainsworth, McTighe

Verbs

- Know (traditional vs standards based)
- Compare (traditional vs standards based)
- Analyze (standards)
- Create (enduring understandings and essential questions)
- Apply (backwards design)
- Familiarize (Bloom's)
- Create and participate (in a simulation)

Ranges...Oh My!

- Remember
- Analyze
- Analyze
- Create
- Apply
- Remember
- Apply and create

Adapted from: Wiggins, Stiggins, Ainsworth, McTighe

Examples Nouns, Verbs and Ranges for Math

Benchmark 5 - 8

Use a variety of strategies, including proportional reasoning, to estimate, compute, solve and explain solutions to problems involving integers, fractions, decimals, and percents.

Indicator grade 6

Algebra:

Perform fraction and decimal computations and justify their solutions: e.g., using manipulatives, diagrams, mathematical reasoning.

Mathematical Processes:

Use deductive thinking to construct informal arguments to support reasoning and to justify solutions to problems.

Examples Nouns, Verbs and Ranges for Math

Nouns	Verbs	Ranges
Variety of strategies	<u>Use</u> strategies	apply
Solutions	<u>Eliminate</u> solutions	apply
Problems	<u>Solve</u> problems	apply
Reasoning	<u>Justify</u> solutions	evaluate
Arguments	<u>Construct</u> arguments	create
Manipulations	<u>Compute</u> solutions	apply

What's Blooming?

An essential question

What opportunities are you providing in your daily instruction for students to think at higher levels?

What's Blooming?

Remember	Recognize/recall	Identify/retrieve
Understand	Classify/Summarize	Illustrate/match
Apply	Implement/use	Carryout/solve
Analyze	Discriminate/distinguish	Compare/discover
Evaluate	Critique/judge	Appraising/debating
Create	Generate/hypothesize	Construct/design

What's Blooming?

- Explicit teaching of the taxonomy so that students know and are able to think critically.
 - Teach kids to know when they know and at what levels.
- Evidence in walk-through
 - The use of the taxonomy should be visible to others viewing the work of the classroom.
- Evidence in student work
 - The student work should demonstrate the level of thinking. Students should be able to analyze at what level the work is demonstrated and defend their response.
- Rewrite quizzes/prompts to make them higher level
 - If we give the students all of the information regarding analysis of something that the teacher gave them, is it really analysis?

Instructional Design and Identity Influence Assessment

- Project Based Learning
- Expeditionary Learning
- Discovery Learning
- Multiple Intelligences Approach Learning
- Inquiry Based Learning
- Performance Based Learning
- Constructivist Learning

They all begin with backward design.

Grade 7 Social Studies

Big Idea: Ancient cultures were sustainable as long as their water supply system was efficient and effective

Enduring Understanding	Essential Questions	Subject Area	Benchmarks and Grade Level Indicators
A civilization needs water, food, shelter and community to survive	How do we measure the success or failure of a civilization based on it's water transport system?		
Water is a commodity that is valued for sustainability	Who wins or loses when water supply is not easily accessed?		
Political systems control migration based on access to water	How do we as members of the greater Cleveland community access water? Who controls our access?		

Enduring Understandings

- Involves the Big ideas that give meaning and importance to facts
- Can transfer to other topics, fields and adult life
- Is usually not obvious, often counterintuitive and easily misunderstood
- May provide a conceptual foundation for basic skills
- Is deliberately framed as a generalization derived from inquiry

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Enduring Understandings for Math Example

- There is a relationship between fractions, decimals, and percentages.
- Decimals, fractions, and percentages are part of a whole.
- It is important to be able to explain, justify, and model a variety of strategies to solve problems.

Adapted from: Wiggins, Stiggins, Ainsworth, McTighe

Essential Questions

- Have no simple “right” answer; they are meant to be argued
- Are designed to provoke and sustain inquiry, while focusing learning and final performances
- Often address the conceptual or philosophical foundations of a discipline
- Raise other important questions
- Naturally and appropriately recur
- Simulate vital, ongoing rethinking of big ideas, assumptions and prior lessons

Understanding by Design Professional Development Workbook
McTighe and Wiggins

Stage Two: Developing a Performance Task

For Performance Tasks use GRASPS:

- **G**oal
- **R**ole
- **A**udience
- **S**ituation
- **P**roduct or performance
- **S**tandards

Stage Three: Designing the Instructional Activities

Instructional Activities: WHERE TO?

- **W**here are we going? Why? What is expected?
- **H**ook students and hold interest
- **E**quip students for expected performance
- **R**ethink and revise
- **E**valuate and reflect on the learning
- **T**ailor learning to varied interests, needs, intelligences, and styles
- **O**rganize and sequence the learning

Making Connections

- Instruction should include multiple indicators/benchmarks within a standard.
- Standards may compliment one another.
- Consider the concept of “Power Standards.”

Power Standards Exhibit

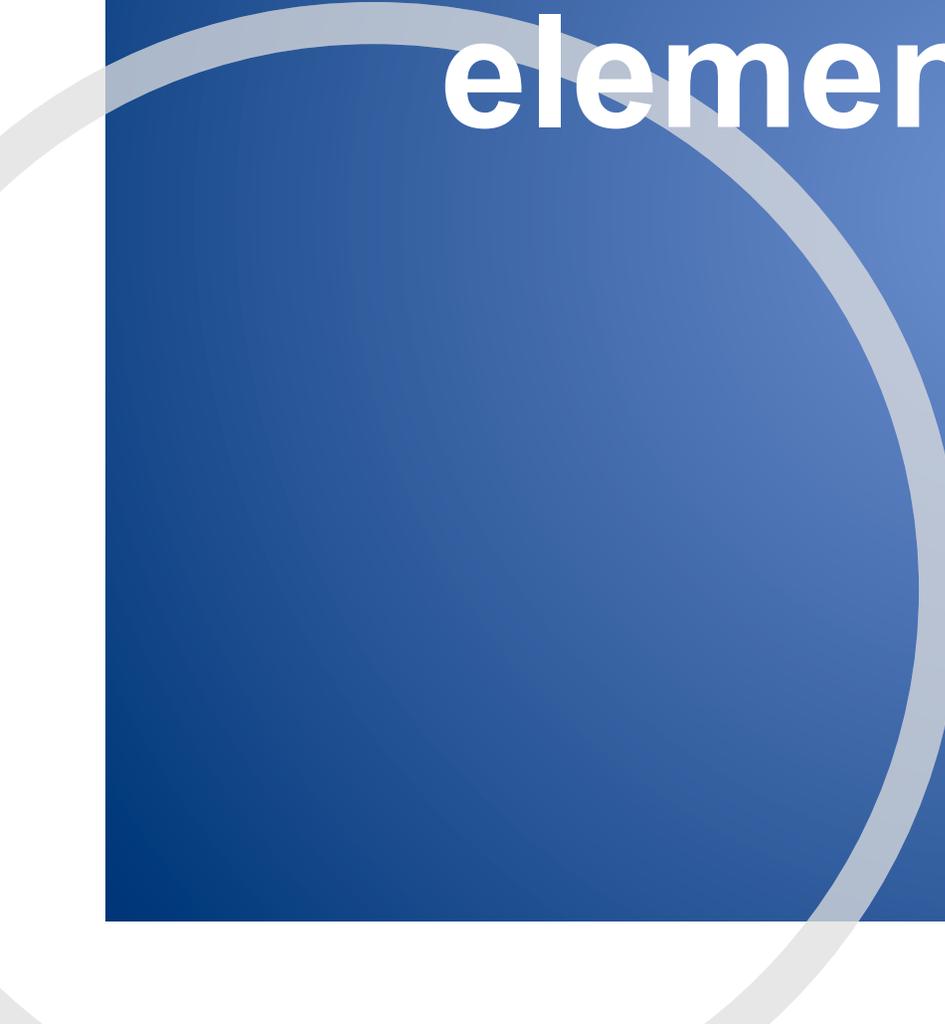
- Endurance – Concepts, skills, and/or knowledge that have lasting value beyond the specific grade level.
- Leverage – Applicability to the other academic disciplines.
- Relevance – For next year's instruction.

Dealing with the Naysayers

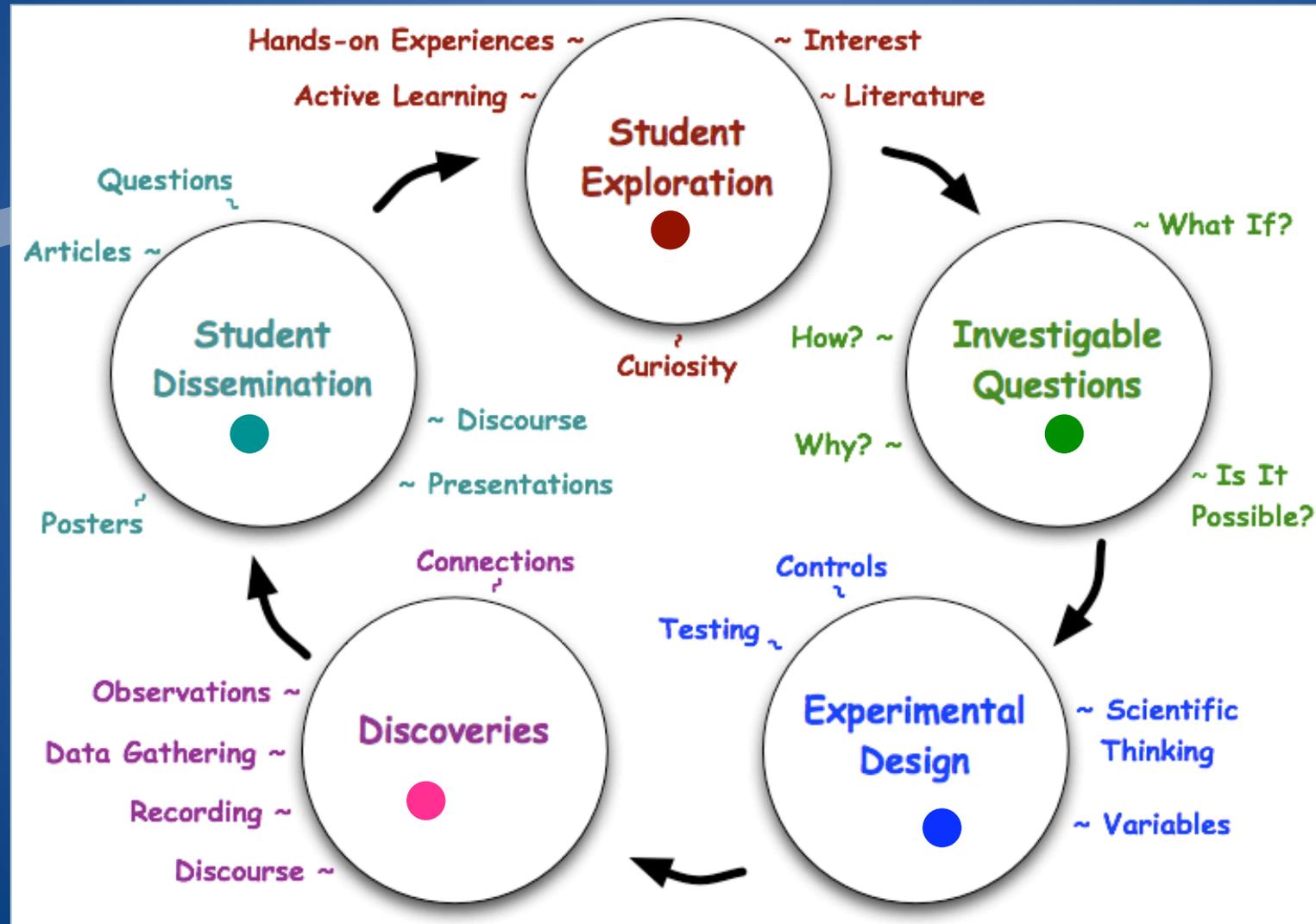
Leadership Keys

- Behavior precedes attitude...you cannot wait until all attitudes change.
- When new practices produce results, they become popular.
- The issue is not popularity, but effectiveness
- Build on the strengths of each individual and nurture the champions

Inquiry as an essential element of STEM



The Inquiry Cycle



The Connection to Learning

Learners need to have opportunities to progress from concrete to abstract ideas.

Learners construct their own understanding by taking an active role in their learning.

The Connection to Learning

Learners construct understanding by connecting new information to what they already believe or know.

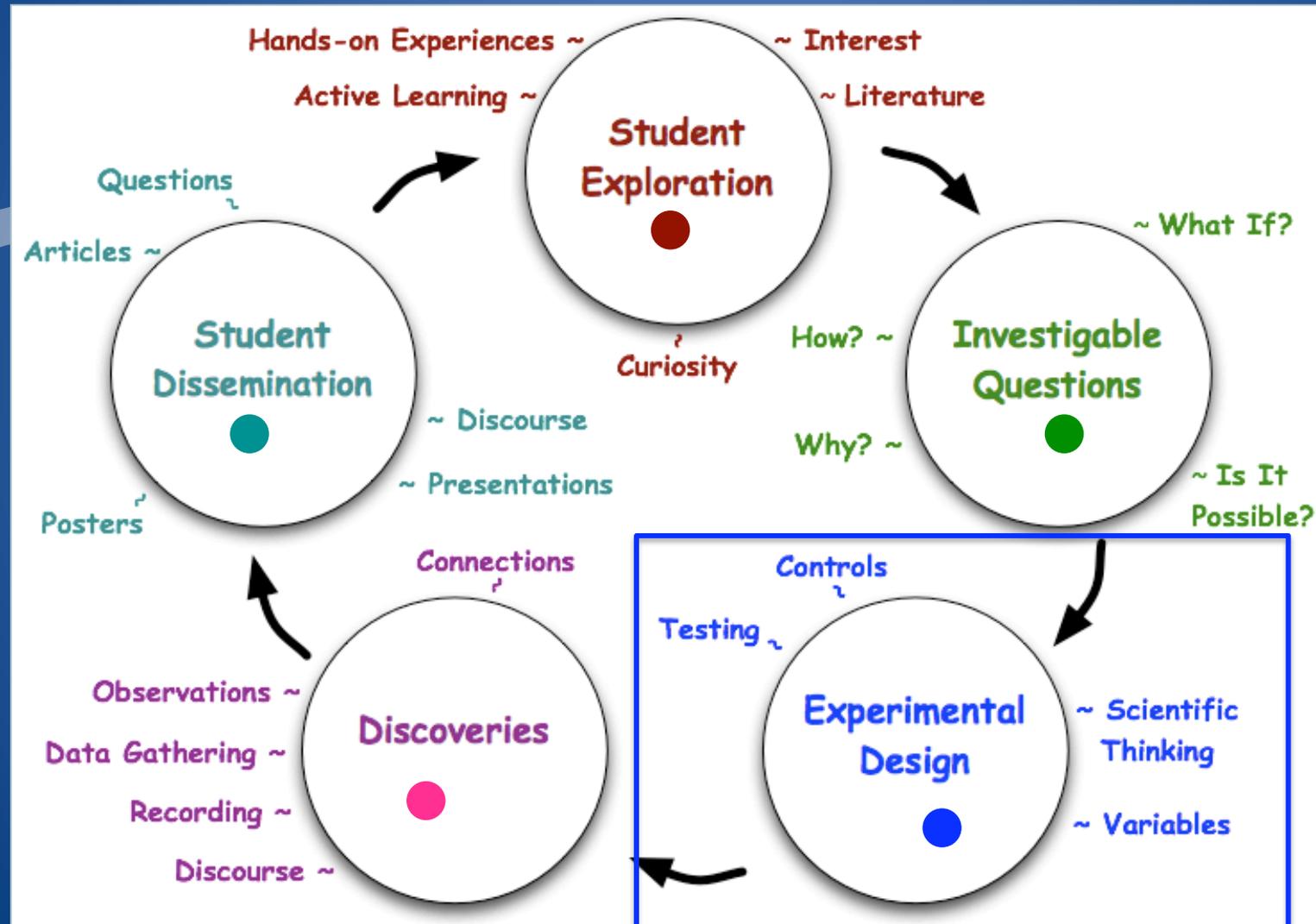
Students and teachers, as a learning community, share responsibility for learning and collaborate on constructing understanding.

Implications for Instruction

*"Learning is something students do,
not something done to them"*

-- NSE Standards, p.20

The Inquiry Cycle



Experimental Design

Investigations can be carried out through:

- *Systematic Observations*
- *Experiments*

Designing Investigations

Systematic Observations

- setting up a situation according to a plan and then carefully observing it over time.

Designing Investigations

Experiment

- comparison between two situations keeping all things the same except one

Designing Investigations

- Choose a question that you would be interested in investigating further
- Form groups of 3 or 4.
- Design an experiment or systematic observation to answer your question.

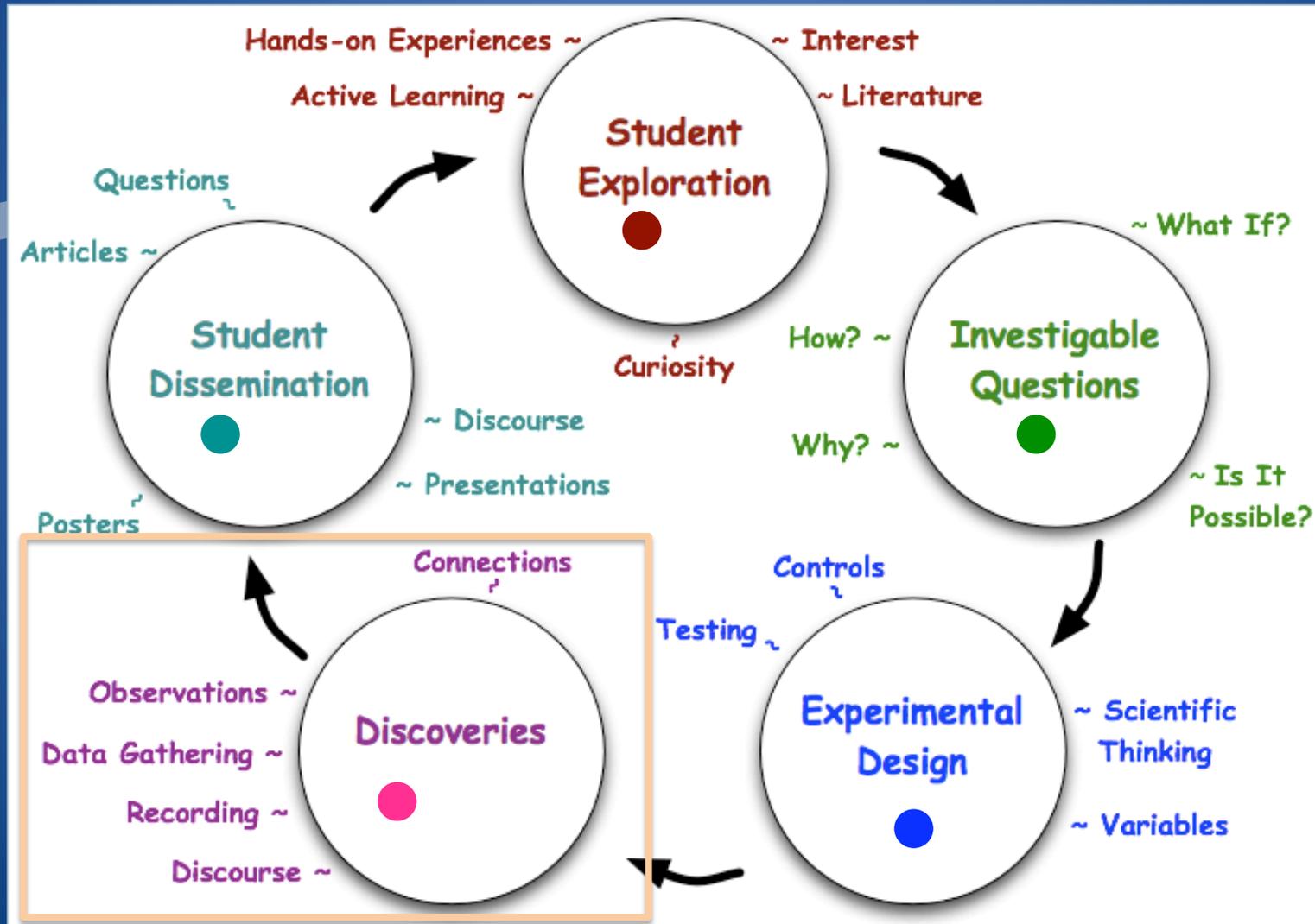
Designing Investigations

- Things to be changed...
- Things to stay the same...
- Results to be looked at...
- Plans to measure the outcome...
- Materials needed...

Designing Investigations

- Forming groups and designing investigations at the different grade levels

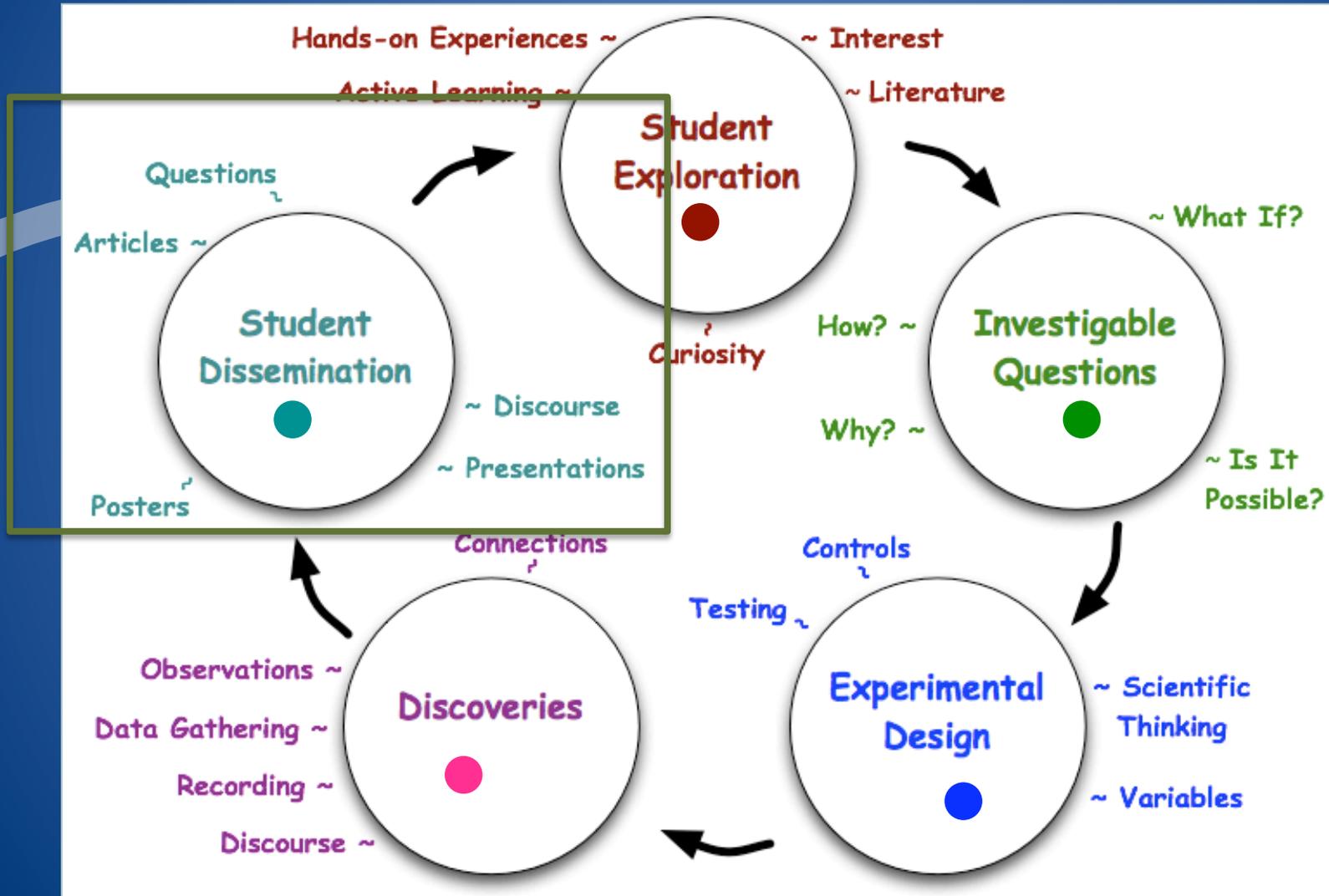
The Inquiry Cycle



Discoveries - Making Connections & Constructing Meaning

- Make claims based on your evidence
- Connect your research to the California Science Standards or to course concepts to be taught.

The Inquiry Cycle

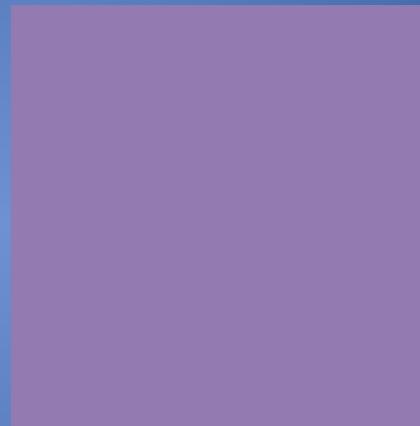
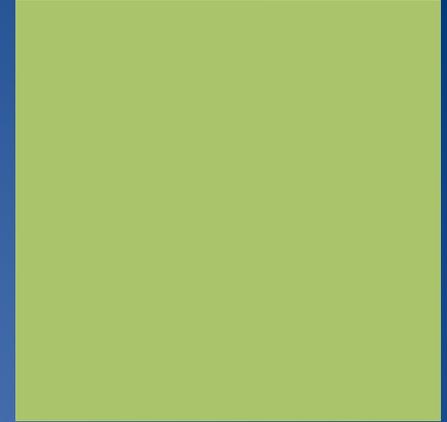


Dissemination - Constructing Meaning & Presenting Findings

- Present your findings.
- Connect your research to the Ohio Benchmarks and Standards or to course concepts to be taught.
- Connect these concepts to real-world applications.

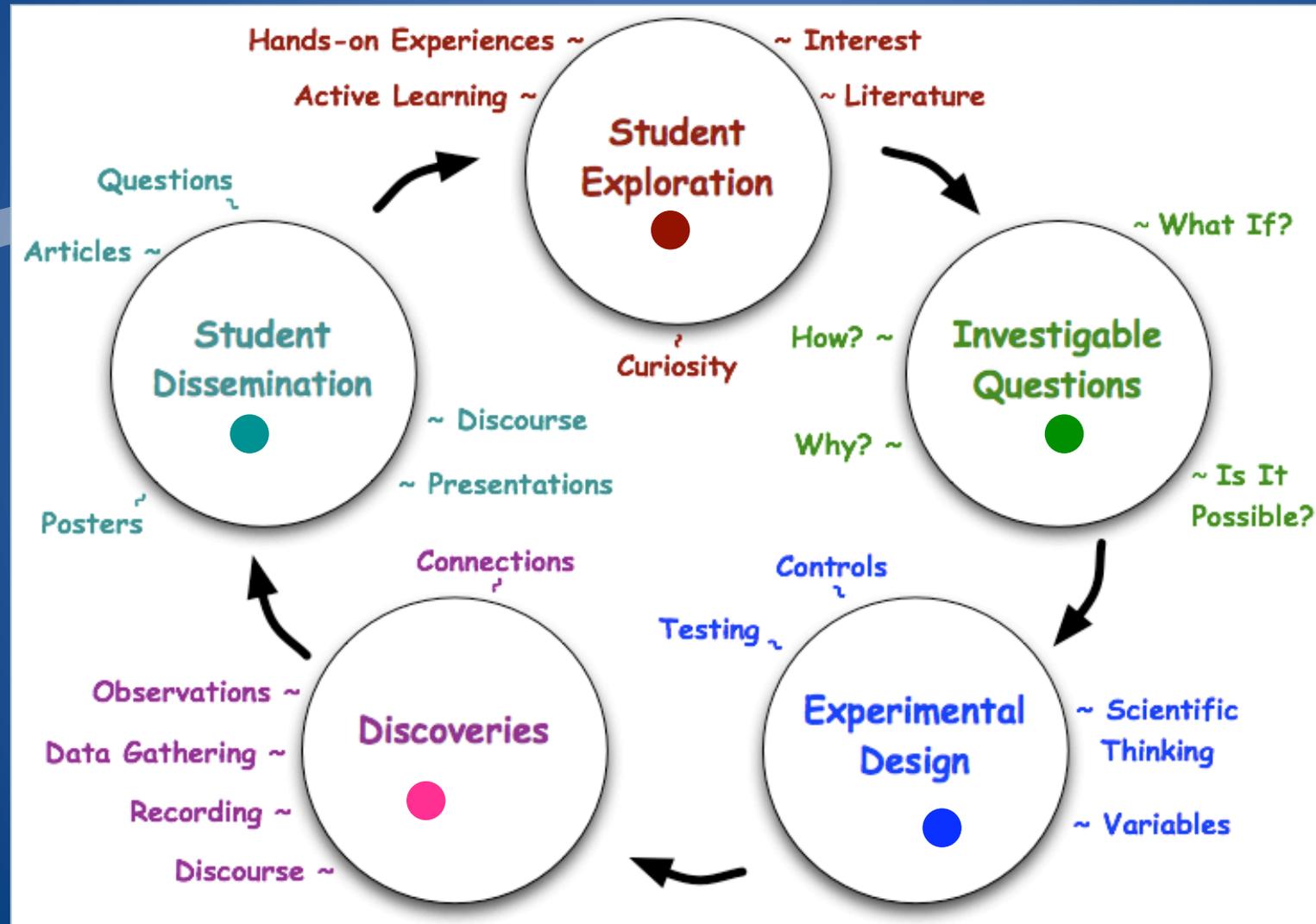


Inquiry



Now we'll apply it to ourselves...

The Inquiry Cycle



Inquiry by Grade Level

Structured Inquiry

- Exploration – what is a critical issue that you and your grade level colleagues need to resolve this school year?
- Investigable Question – brainstorm why you think that this issue is a problem using the interrelationship diagram
- Experimental Design – using a fishbone diagram, determine a pathway by which this root problem may be resolved
- Discoveries – record your findings as the year progresses
- Dissemination – at the end of the school year, measure the experimental design's effectiveness and exhibit your new learning

Understanding STEM

Text Based Dialogue

Rule of Three

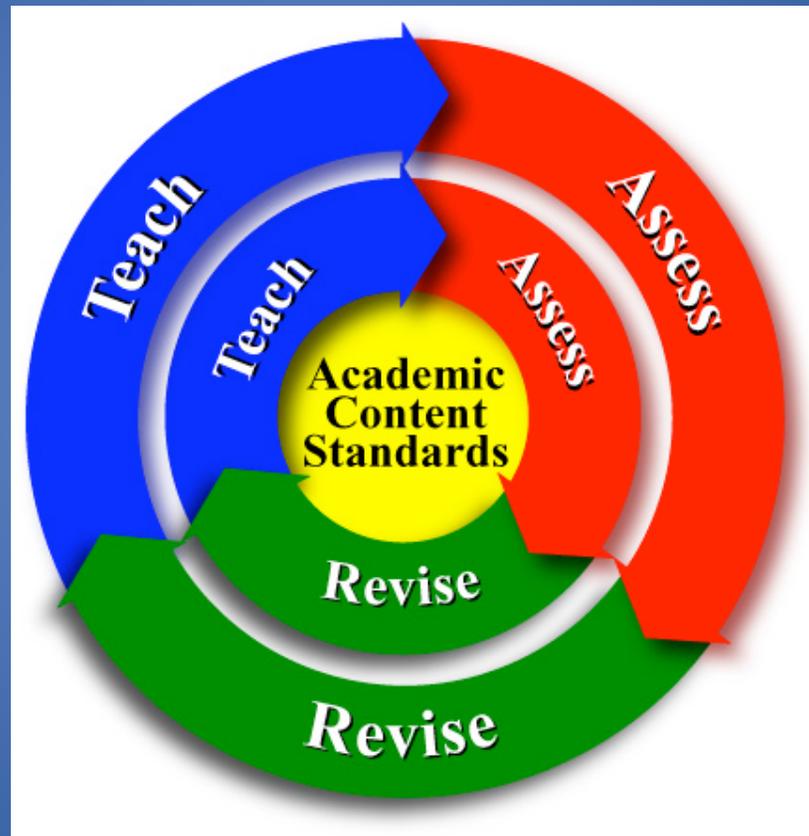
Text Based Dialogue

Protocol: Three Rounds of Conversation

Procedure:

1. Assign Roles – Facilitator, Recorder, Time Keeper
2. Read Text Assignment – 10 minutes
3. Round Robin Format – Each person must formulate at least one idea to start, then it is open to the entire group for the remainder of the time. During each round, start with text/data from the reading starting with “The author says...”
 - a) What literally jumps out at you as interesting? (text, then why interesting) 5 minutes for this round. Each should mark text to indicate that someone in the group has found it interesting.
 - b) What trends in assessment do you see in your school compared to the author’s assertions? (Text reference, then interpretation) 10 minutes
 - c) If the central purpose of our educational system is to provide opportunity for access in tomorrow's world, how do our assessment practices give "practice" to the accountability for knowledge and skills needed for the 21st Century? (trend from round b, then articulate assumptions) 10 minutes
4. Debrief Conversation

Standards-Based Education



Assessment Rich Educational Benefits

- **Focus and clarity are brought to the curriculum.**
- **Rigorous academic content is taught at all grade levels.**
- **Standards provide a system for communicating expectations.**

Assessment Driven Practice Means That...

- **Standards guide instructional decisions at the classroom level.**
- **The focus of instruction is on student learning.**
- **Expectations for learning are the same for all students.**

Leadership Keys

- Assessment is the key to influencing every other element of classroom performance
- The school leaders must promote collaboration in assessment design and evaluation
- The school leaders must focus professional development on assessment quality
- Think about coverage versus un-coverage of content capacities

Understanding by Design

Stage 1 – Desired Results

Establish Goals

Content Standards (clumping)

- Standards, benchmarks, indicators as sources

Enduring Understandings

Nouns, Verbs and Ranges

Essential Questions

Students will know... Are able to do...

Unpacking the standards

Stage 2 – Assessment/Evidence

Performance Tasks

GRASPS

Other Evidence

Formative, diagnostic, summative, rubric

Stage 3 – Learning Plan

Learning Activities

WHERJO

Text Based Dialogue

- 30 minute discussion
- Remember to include all table members in the dialogue
- Start with the following essential questions:
 - How does this example of student work demonstrate STEM qualities as described by Metro's philosophy?
 - How might the teacher assess this work?
 - What qualities of 21st Century learning might be assessed?
 - What examples of this kind of are done at your school? How do you assess them?
 - Each speaker should quote or reference the text before speaking.



Baraka Project

So, what are the essential characteristics of a STEM graduate?

AFFINITY DIAGRAM

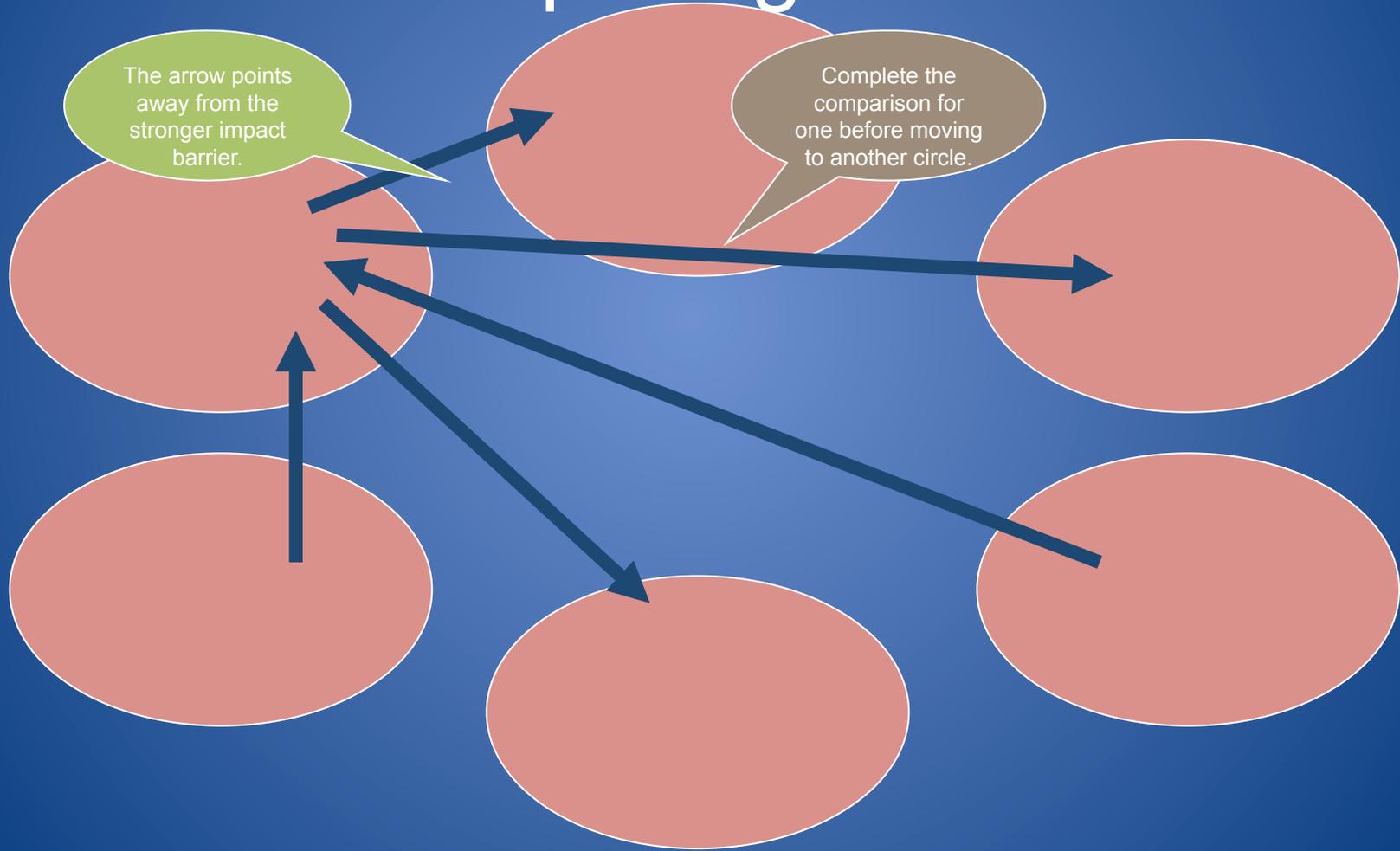
Interrelationship Diagram

Barrier Analysis – What is keeping your assessment system from growing?

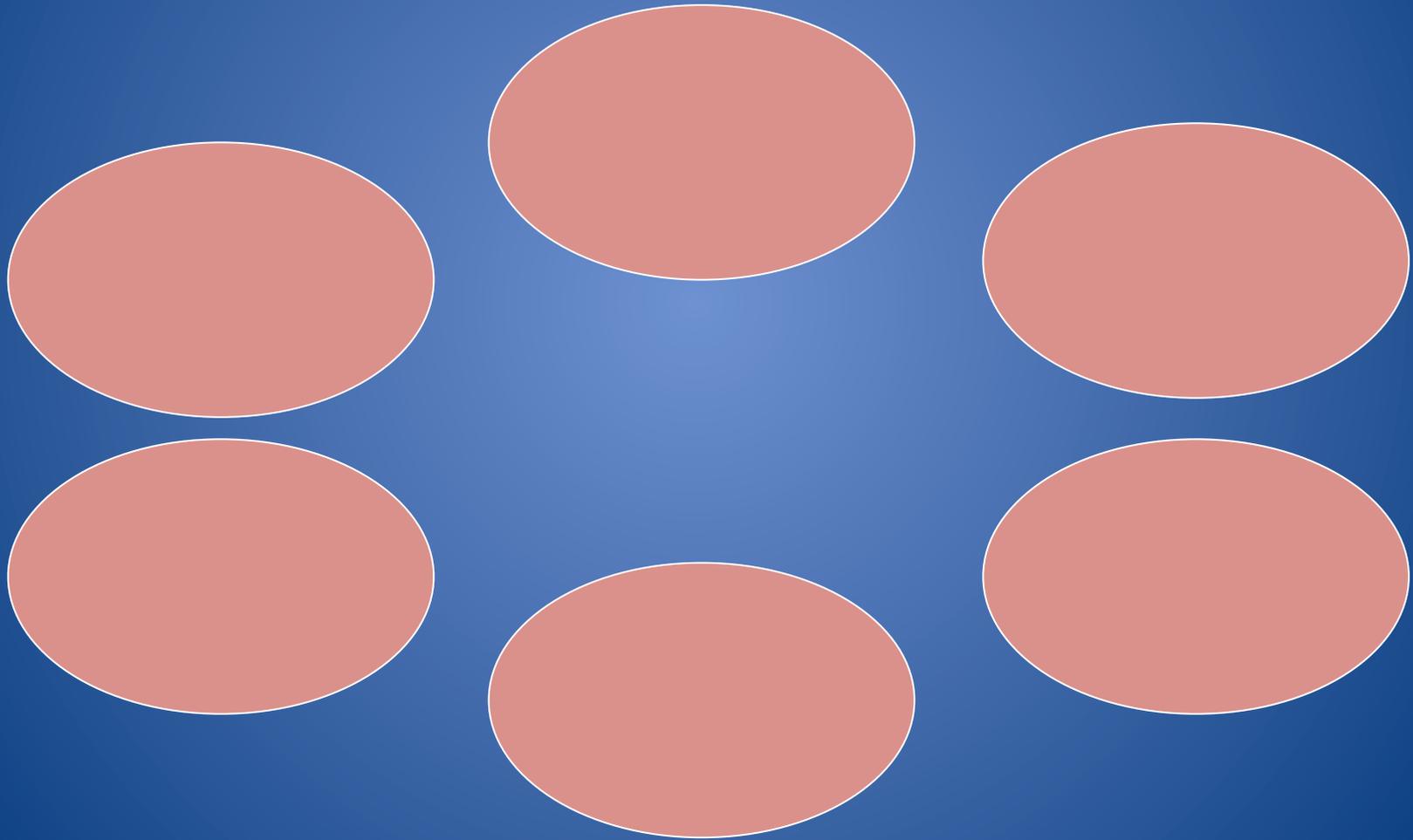
Brainstorm

- List your top 5 barriers
- Eliminate any barrier that is beyond your control within the school (poverty, building condition, etc.)
- Share your barriers across the group – if it is similar to something you have already said, go to another idea
- As a table group select the overall five that best represent all of your circumstances

Interrelationship Diagram

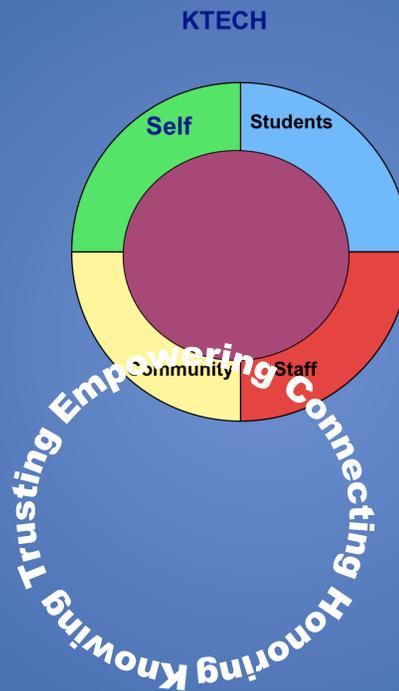


Interrelationship Diagram



What is the biggest impacting factor to your quest to personalize your learning environment?

Personalization



Five Essential Components to Personalization

Knowing

Trusting

Empowering

Connecting

Honoring

Four Essential Lenses Through Which Personalization Should be Examined

Students

Staff

Community

Self

- Brainstorm on post-it notes the way/ways in which your STEM school KNOWS each student well
 - One idea per post-it please
 - Place a K on the upper right corner





- Make an affinity Diagram of the ideas gathered for KNOWING students
 - One person read one post-it to the group. Anyone with the same or similar idea, hand over the post-it and create a group.
 - Title the group.
 - Place the group on your poster paper.
 - Move to the next person to read one idea.
 - Continue until all ideas have been categorized.



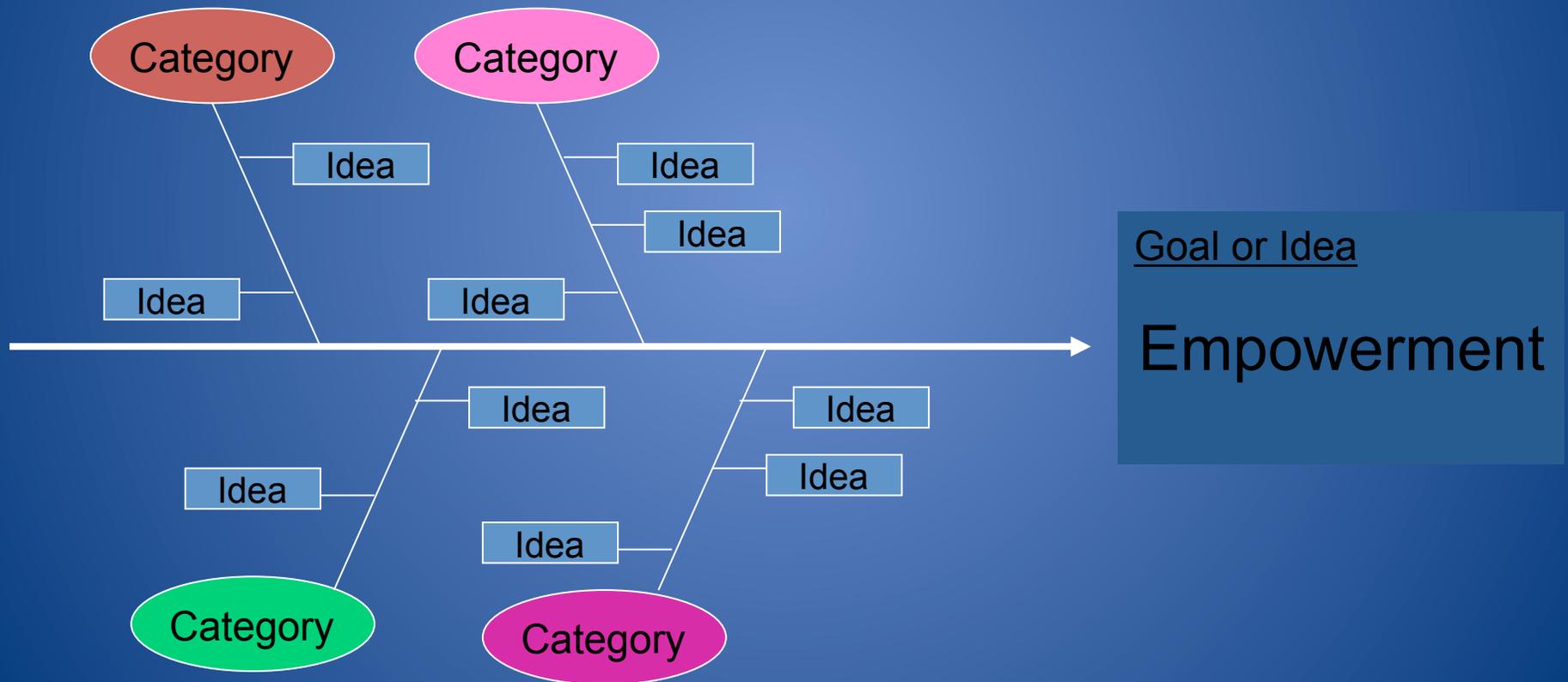
- Brainstorm on post-it notes the way/ways in which your STEM school demonstrates TRUST between the students and the school
 - One idea per post-it please
 - Place a T on the upper right corner
- Create Affinity Diagram of TRUST



- Brainstorm on post-it notes the way/ways in which your STEM school EMPOWERS each student
 - One idea per post-it please
 - Place an E on the upper right corner
- Create a fishbone of EMPOWERMENT



Fishbone Technique



- Brainstorm on post-it notes the way/ways in which your STEM school HONORS each student
 - One idea per post-it please
 - Place an H on the upper right corner
- Create affinity diagram for your STEM school's HONORING practices



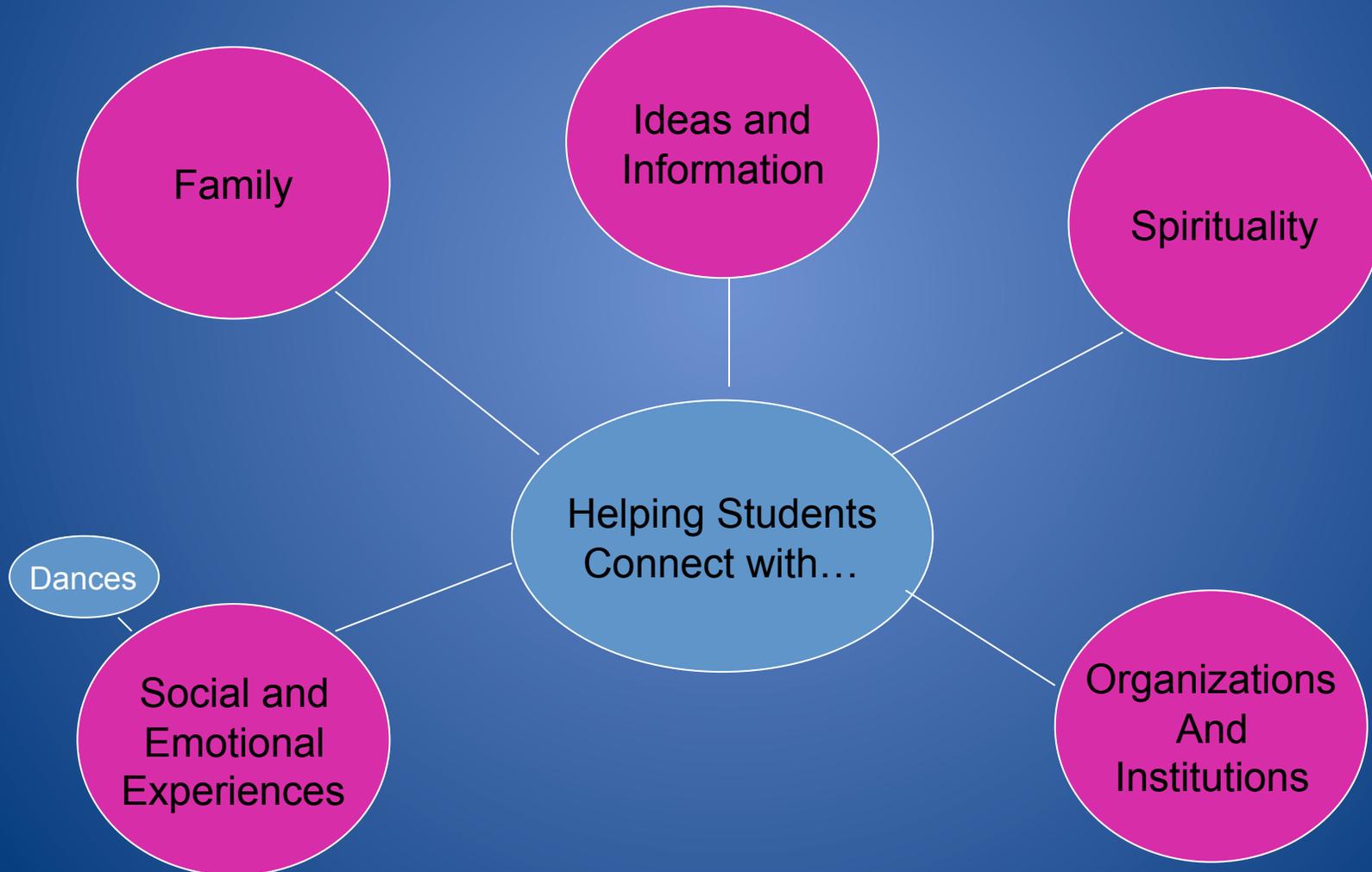
Connecting

1. Social Connections
2. Connections with Information/Ideas
3. Connections to Organizations/
Institutions
4. Family Connections
5. Spiritual Connections

- Brainstorm on post-it notes the way/ways in which your STEM school connects with each student in each of the areas articulated through the Thompson and Hallowell study Finding the Heart of a Child, 1992
 - One idea per post-it please
 - Place a 1, 2, 3, 4, or 5 on the upper right corner to designate the kind of connection
- Create an affinity map for your STEM school's CONNECTION practices.



Affinity Mapping Technique



Staff and Community

The discussion is valuable and necessary for all stakeholders

Using the format, find out what the expectations are for your staff

- Convene focus groups of staff members to establish the expectations for themselves and to learn from each other
- Convene focus groups of community members (parents, businesses, etc.) to establish their expectations for the school with regard to personalization in the five areas.
- Convene focus groups of students to establish the expectations for the staff when it comes to personalizing their experiences

Welcome Back!

The Inquiry Continuum

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Making Connections

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STEM Identity

How to assist your students/
parents/other teachers in
understanding what STEM means
to your community.

Identity



Identity: why does it matter to the process?

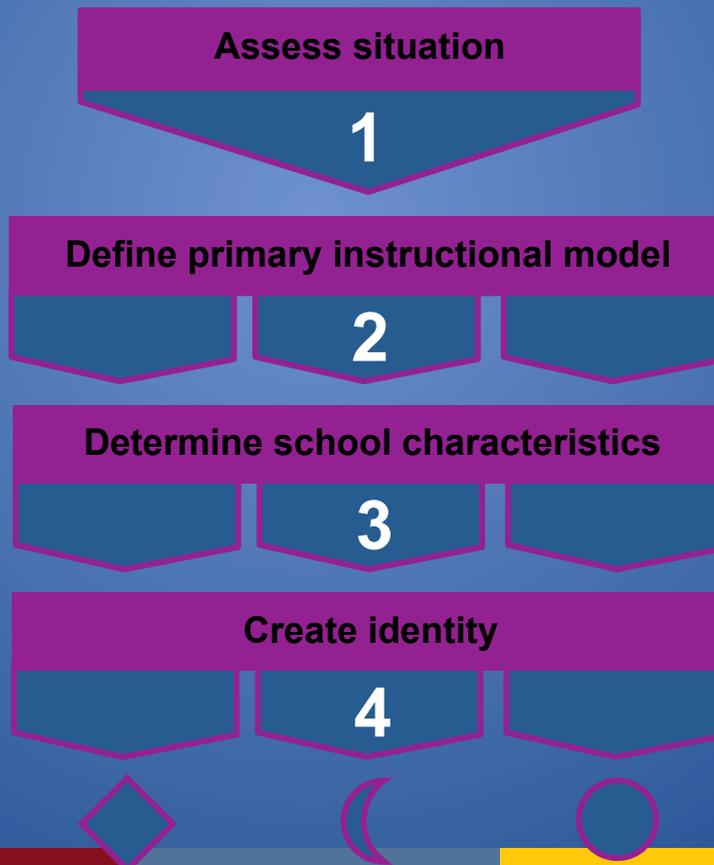
A strong school identity should:

- **Engage** students, parents, and teachers in our vision (connects us to others)
- **Improve understanding** of what we do (differentiates us from other schools)
- **Increase awareness** of who we are (makes us known)

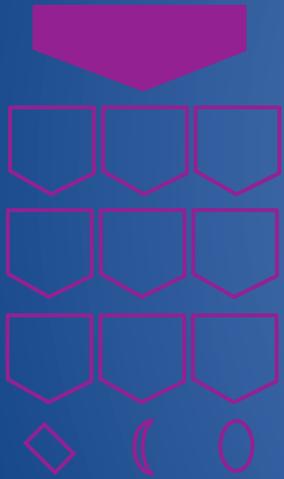
*We want students, parents, teachers, and the public to **recognize, remember, and request** our school and its services.*

Identity Design Process

Use strategic planning to create unique identity

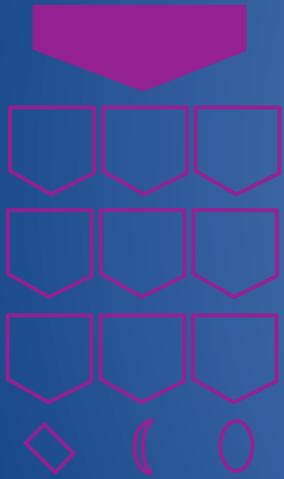


Step one: assess the situation



What are our beliefs and values? How do we communicate it to our community? How are our services personalized, or not personalized to the unique needs of the community?

Assessing the Situation



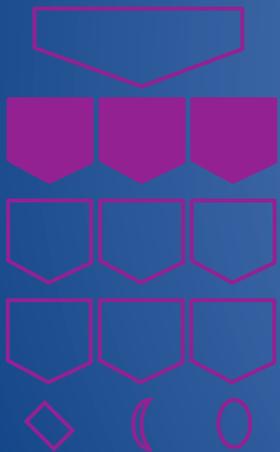
Take a look at your school and school data

- Systems analysis using an inventory (KnowledgeWorks)
- School Portfolio (Victoria Barnhart)

What gaps exist?

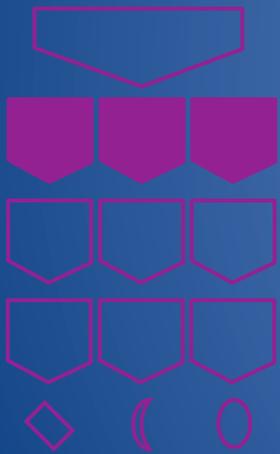
Look at what is, and determine what needs to be.

- Where are there instructional gaps in performance?
- Where are there gaps in relationship development?
- Where are there gaps in communication?



Begin to establish benchmarks that will demonstrate that the gaps no longer exist or that the gaps are narrowing in their impact.

Step two: define primary instructional model



How will our STEM more personalized environments inspire academic achievement?

Step two: define primary instructional model

Start with your benchmarks for success.

Research best practices to determine the qualities you want your STEMer, more personalized environment to look like.



- Educator’s Knowledge Network
- School Redesign Network
- Educational Alliance (Breaking Ranks)
- STEM School Workshop
- STEM School Project

Consider formulation of your own model as a combined effort.

Assess and evaluate options

Define your learning environment’s model

Look at the selection of the primary instructional model as a coordinating effort to be known for what you believe in, rather than a constraint that keeps you from personalization.

Step three: determine school characteristics and design qualities



What learning approaches will we use to deliver our instructional model?
What features be displayed through our system?

Set Instructional Targets

- What are the state mandates that control what is taught?
 - Standards...
- What board policies govern the practices of student performance?
 - Number of credits...

Step three: determine school characteristics

point of view

Themes and characteristics are a “hook,” not a solution, to increase performance outcomes.

STEM schools want to focus on inspiring students to learn and developing strong relationships among students, parents, teachers and the community. Focus on teaching, learning, relationships and achievement. Themes should be approached merely as a “hook” to engage students in learning, not the focus of the school.



Step three: determine school characteristics to be implemented

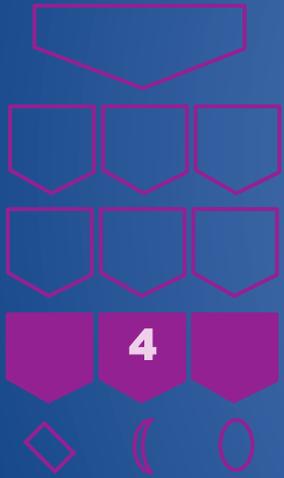
Example



Learning becomes an adventure in **leadership and self-esteem**. Students and teachers form close-knit **expeditionary teams** that delve deeply into core subject areas through **classroom research and fieldwork** designed to create a culture of academic excellence and **collaborative team** effort through the exploration of **social and environmental issues**.

How would course descriptions be written and communicated?

Step four: create identity



How do we want to be known?

Step 4: create identity

Strong “brandable” identity

Accurate

Accessible

Beneficial

Clear

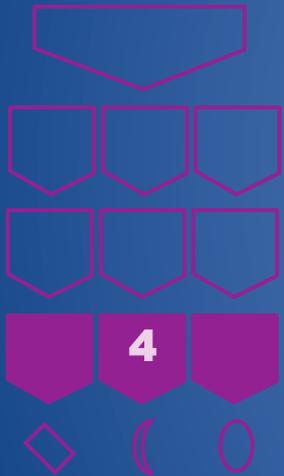
Compelling

Consistently Applied

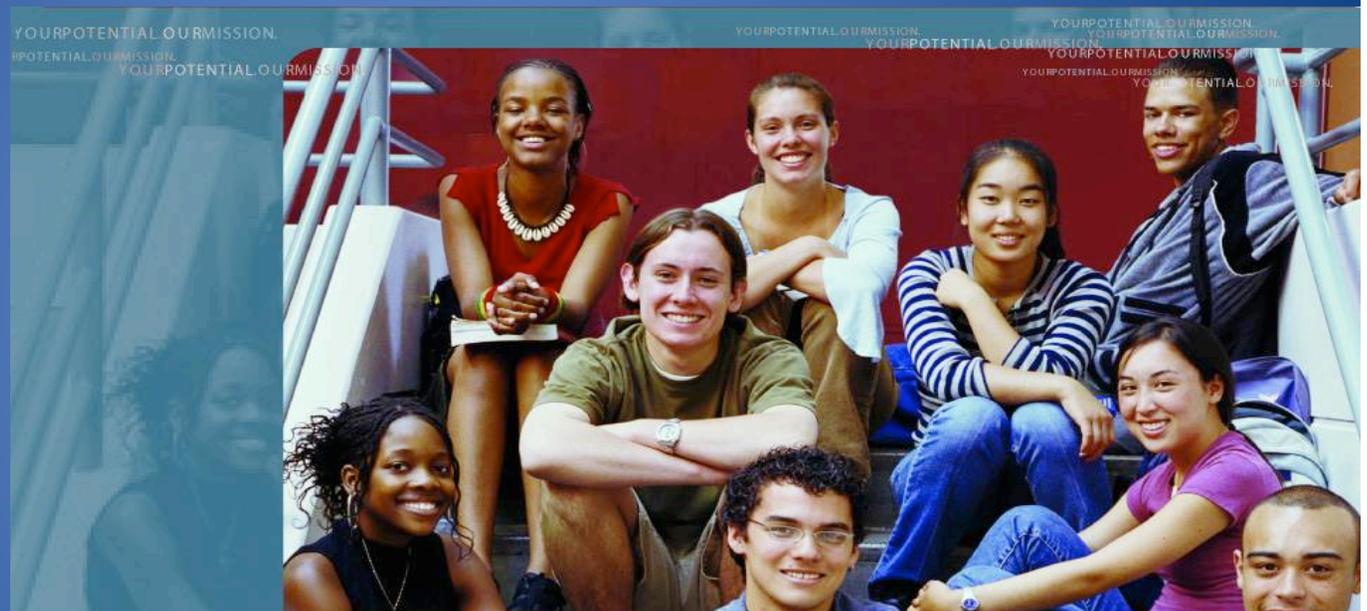
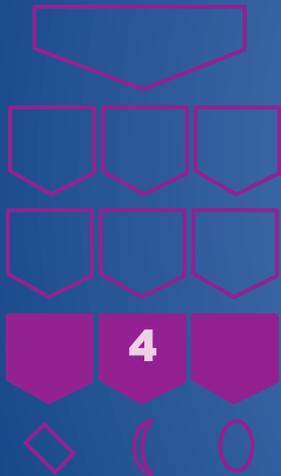


WAL★MART

What are your particularly memorable core messages about your school's learning environment?



An Example



Your Potential. Our Mission. **metro** 

Turning college aspirations into reality through personal relevance, academic rigor and transformative relationships.

Founding Partners

Battelle
The Business of Innovation

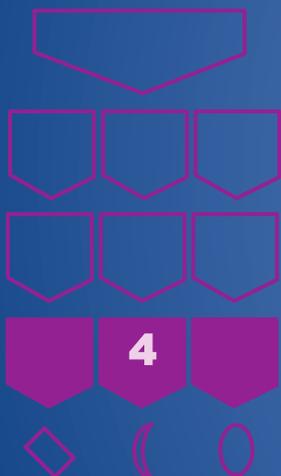
THE OHIO STATE UNIVERSITY


Educational Council

Create a messaging platform

Messaging platform components:

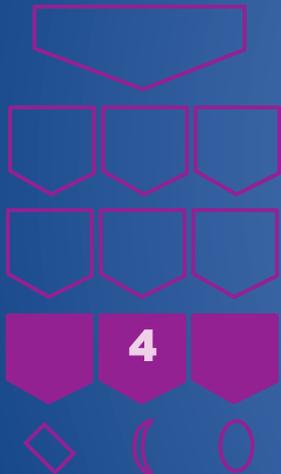
- Our **vision** is...
- We **describe** ourselves as...
- We are **known** for three distinct features...
- Reasons people will **value** what we do...
- Here are five “**fast facts...**”
- The **two stories** we tell are...
- Our **tag line** is...



Create a messaging platform

Messaging platform components:

- Our **vision** is...
 - **Metro High School**
 - Turning college aspirations into reality through personal relevance, academic rigor and transformative relationships.
- We **describe** ourselves as...
 - **Metro High School**
 - Designed to serve students who want a personalized learning experience that prepares them for a connected world where math science and technology are vitally important
 - STEM intellectually vibrant learning community of 400 students in 9th through 12th grade
 - Is a public school option that was founded by a unique partnership of the Educational Council (16 metro school districts), The Ohio State University, and Battelle Memorial Institute



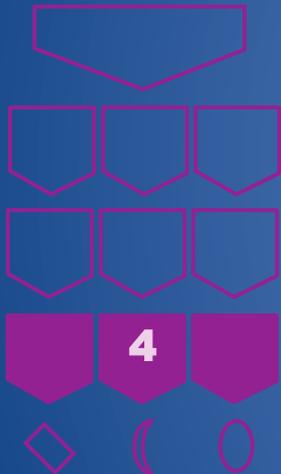
Create a messaging platform

Messaging platform components:

- We are **known** for three distinct features...

- **Metro High School**

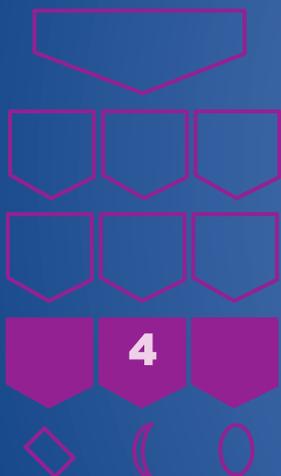
- Core Prep: 9th and 10th grade features extended time on core only preparation (math, science, social studies, Spanish, and language arts) with an inquiry approach
- College Readiness: 11th and 12th grade features participation in advanced coursework, independent research, internships, and college participation at The Ohio State University
- Metro Partnership Group: Unprecedented partnership that connects the public schools in Franklin County with the resources of the nation's largest research organizations – Battelle – and the state's flagship higher education institution – The Ohio State University, and a national network of education reform – The Coalition of Essential Schools.



Create a messaging platform

Messaging platform components:

- Reasons people will **value** what we do...
 - **Metro High School** is designed to serve students who seek the power and responsibility to change their circumstances and make higher education a reality.
- Here are five “**fast facts...**”
 - **Metro High School**
 - Academics emphasize how math, science and technology shape our world
 - Students participate in an integrated curriculum that fosters critical thinking, creativity and communication
 - Students learn in a community that honors democracy, diversity and ethical leadership
 - Faculty and mentors focus on the talents of the whole student
 - Faculty and students work on projects that benefit the greater community



Create a messaging platform

Messaging platform components:

- The **three stories** we tell are...

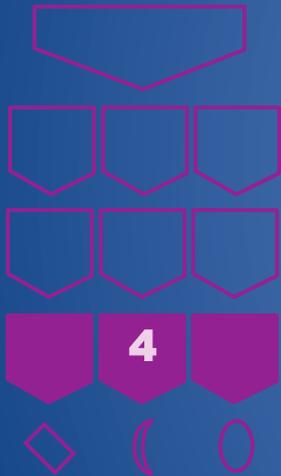
- **Metro High School**

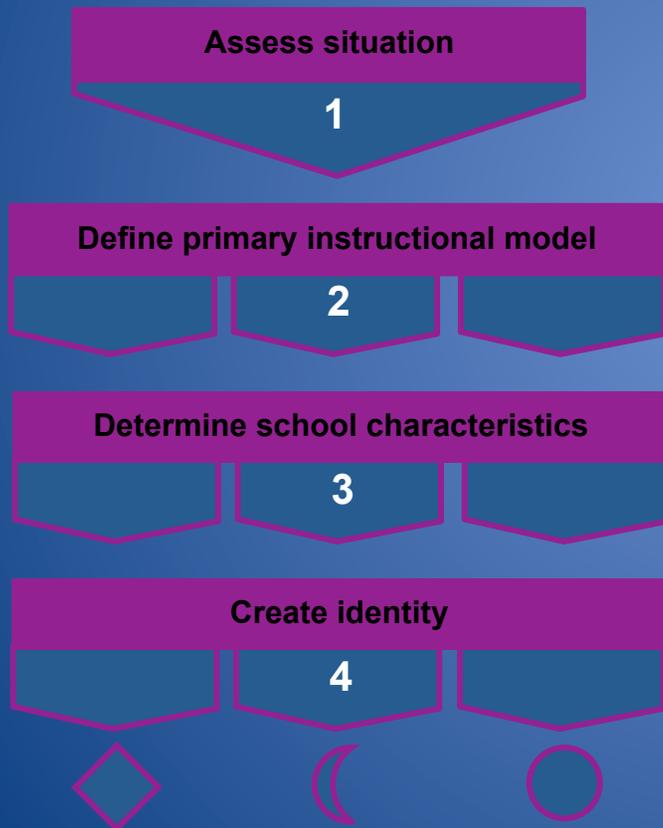
- Student who has yet to be engaged, but is interested in field studies related to math science or technology...
- Student who did not have access to college completes freshman year at The Ohio State University as a senior in high school...
- Student spends 30 days as a research assistant to a Battelle scientist working on nanotechnology project...

- Our **tag line** is...

- **Metro High School**

- Your potential. Our Mission.





Step one

- SWOT analysis
- Current and desired student experience
- Community, school, individual assets and needs

Step two

- Rubric benchmarks or Inventories
- Potential primary models
- Relevant data analysis
- Primary model selection
- Campus coordination

Step three

- Potential learning approaches
- Relevant data analysis
- Characteristics selection

Step four

- Name
- Course
- Description
- Messaging platform – how will the standards be delivered?

Title

- Text