Growing Mathletes: A Model for Integrating Growth Mindset and Other Content in Informal Settings

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Growing Mathletes

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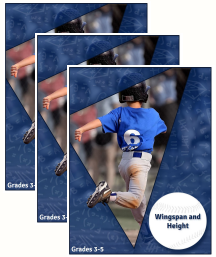
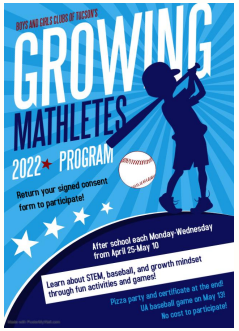
Overview

14 Lessons and 2 Performanced Based Tasks that incorporate baseball, math, and growth mindset



Implement afterschool and summer programs



Train Facilitators at Informal Learning Sites

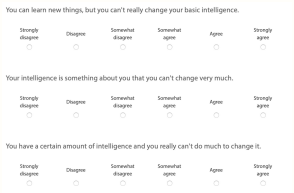
BOYS & GIRLS CLUBS

MIKID improves the behavioral health and wellness of children and youth through a family-centered approach.

HITTING FACTORY

HOUSTON ASTROS YOUTH ACADEMY

Collected Data from Facilitators Youth



In each lesson

Overarching theme

Mathematical concept

Growth mindset concept

Reflection to youths' lives

5

Session 3 - Throwing Speed and Distance

Start the session by posting and discussing this quote:

"The team with the best athletes doesn't usually win. It's the team with the athletes who play best together." -Lisa Fernandez

Key Ideas in this Session: Youth will learn about the time it takes for a ball to travel due to different pitch speeds and different pitching distances. Youth will also learn about the value of different skills and abilities in baseball and other activities.

Driving Questions:

1. How does one's growth mindset contribute to their team's overall success?
2. How can we use different tools to measure distances (home plate to the pitcher's mound)?
3. How does pitch speed affect the time it takes a baseball to reach home plate?

Math Standards: **3.MD.4** Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch.
4.MD.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table.

Growth Mindset Connection: The value of collaboration. Everyone has unique skills to contribute to the team.

Why Growth Mindset

Students with a *growth mindset* believe that intelligence is malleable rather than fixed; they see challenges as opportunities to deepen understanding and believe they can learn more through effort. In contrast, students with a *fixed mindset* see intelligence as fixed, innate trait; they may avoid challenges, and give up easily when faced with difficult tasks (Kravosky, 2007)

Growth Mindset Principles

1. *The value of collaboration. Everyone has strengths to contribute to the team.* Many tasks require a number of different skills and abilities. None of us may have all of these skills and abilities, but as a team we can draw on the strengths of each team member to succeed.
2. *The power of effort and persistence.* We can improve and reach our goals through goal setting, effort, and progress tracking. Our effort pays off when we persevere and keep working toward our goals.
3. *The value of mistakes in supporting learning.* Mistakes are a normal and valuable part of the learning process. We can learn from our mistakes through reflecting on our errors and taking lessons from them. Mistakes make our brain grow!
4. *Malleability of the brain and the role of struggle in learning.* The brain can get stronger and smarter. New connections between neurons in the brain change all the time as a result of our experiences.
5. *Praise the process, not the person.* Modify your language to focus on the process instead of the person. Praise students when they work hard to accomplish a difficult task.

https://www.mindsetkit.org --- https://www.youcubed.org/resource/growth-mindset/

Growth Mindset Lessons

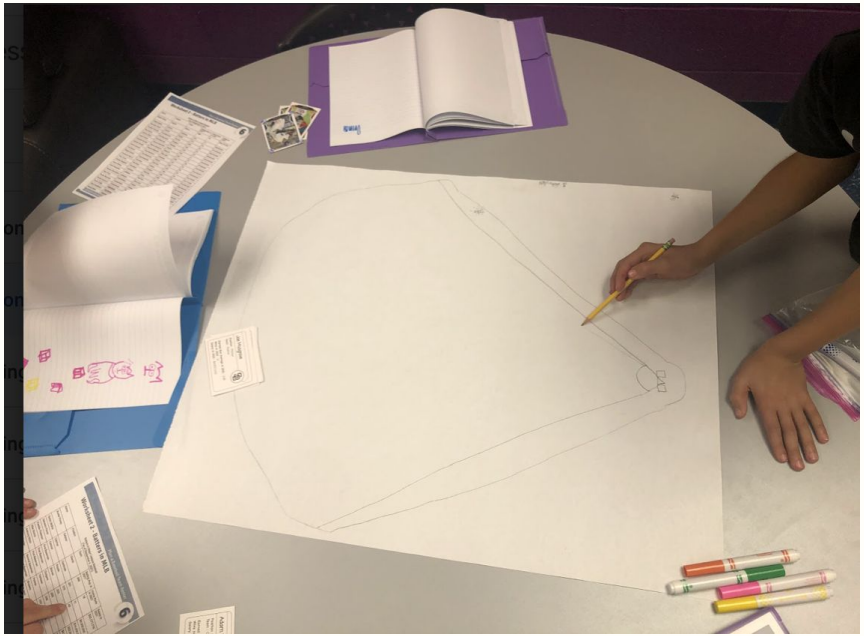
Lesson	Growth Mindset Principle
Base Running	#4 *Malleability of the brain and the role of struggle in learning*
Baseball Field Geometry	#4 *Malleability of the brain and the role of struggle in learning*
Baseball Positions	#1 *The value of collaboration. Everyone has strengths to contribute to the team.*
Baseball Statistics	#3 *The value of mistakes in supporting learning*
Fielding Percentage	#3 *The value of mistakes in supporting learning*
Launch Angles	#2 *The power of effort and persistence*
Measuring Heart Rate	#2 *The power of effort and persistence*

Lesson	Growth Mindset Principle
Sports Vision	#4 *Malleability of the brain and the role of struggle in learning*
Strike Zone	#3 *The value of mistakes in supporting learning*
Throwing Distance	#1 *The value of collaboration. Everyone has strengths to contribute to the team.*
Broad Jump	#2 *The power of effort and persistence*
Elasticity	#4 *Malleability of the brain and the role of struggle in learning*
Nutrition	#2 *The power of effort and persistence*
Wingspan	#2 *The power of effort and persistence*

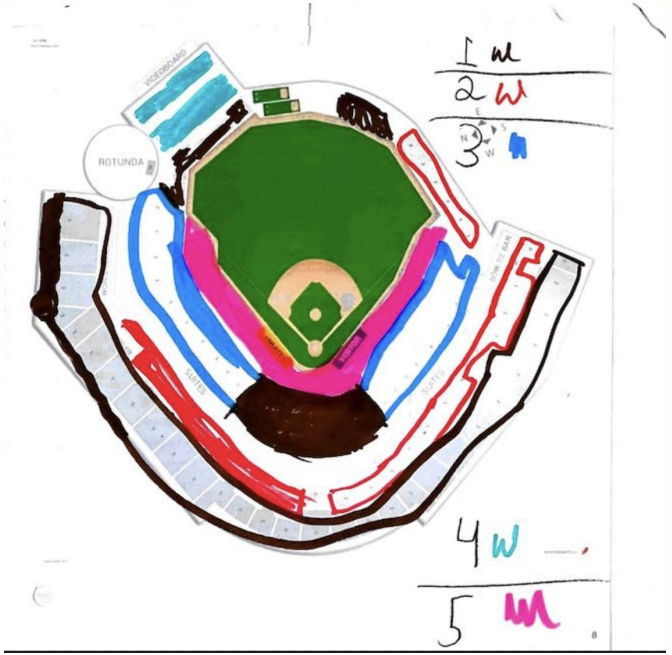
Tally: P1 = 2, P2 = 5, P3 = 3, P4 = 4, P5 = 0

Performance Based Tasks

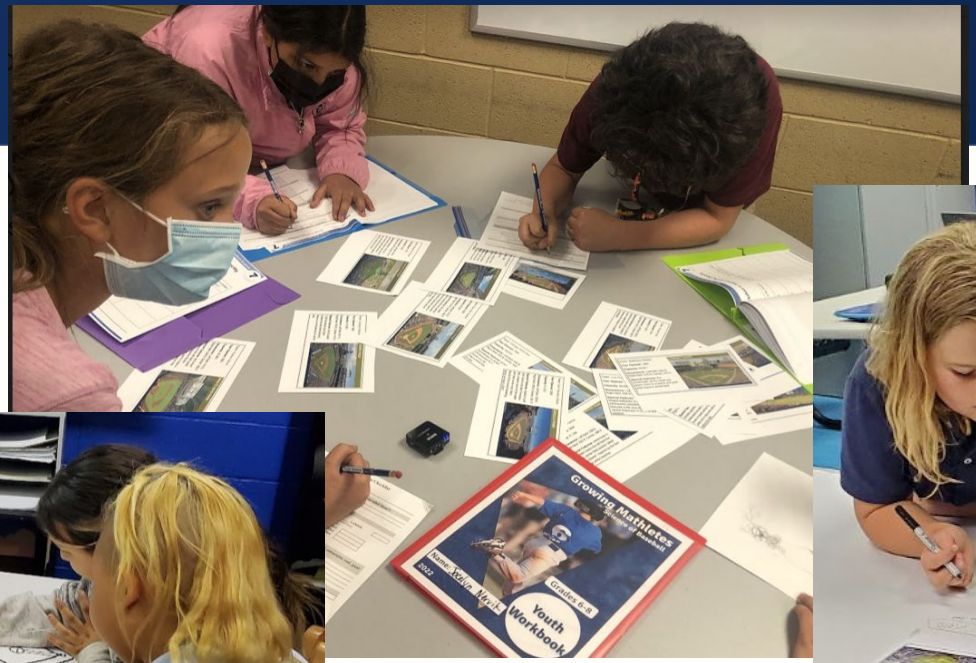
Build Your Own Roster



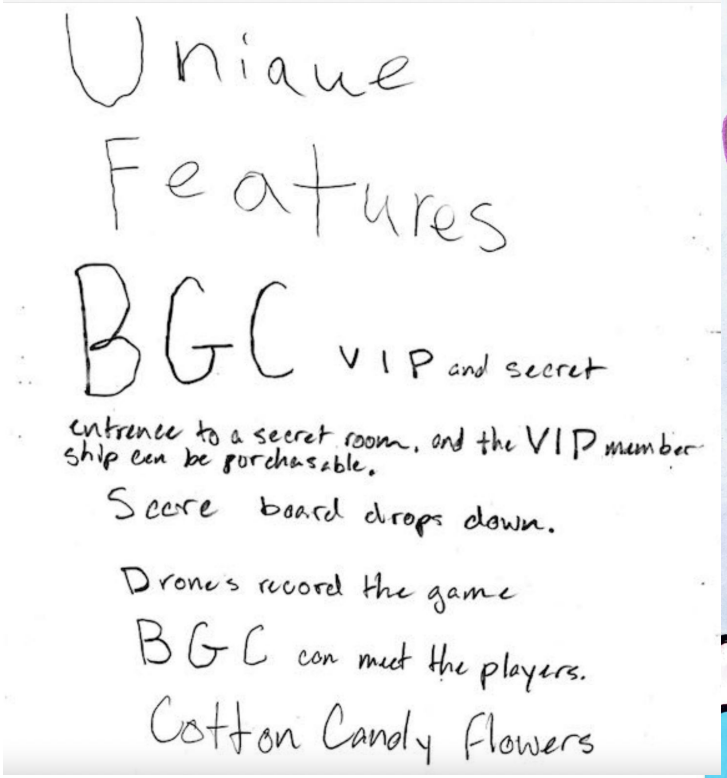
Design Your Own Stadium

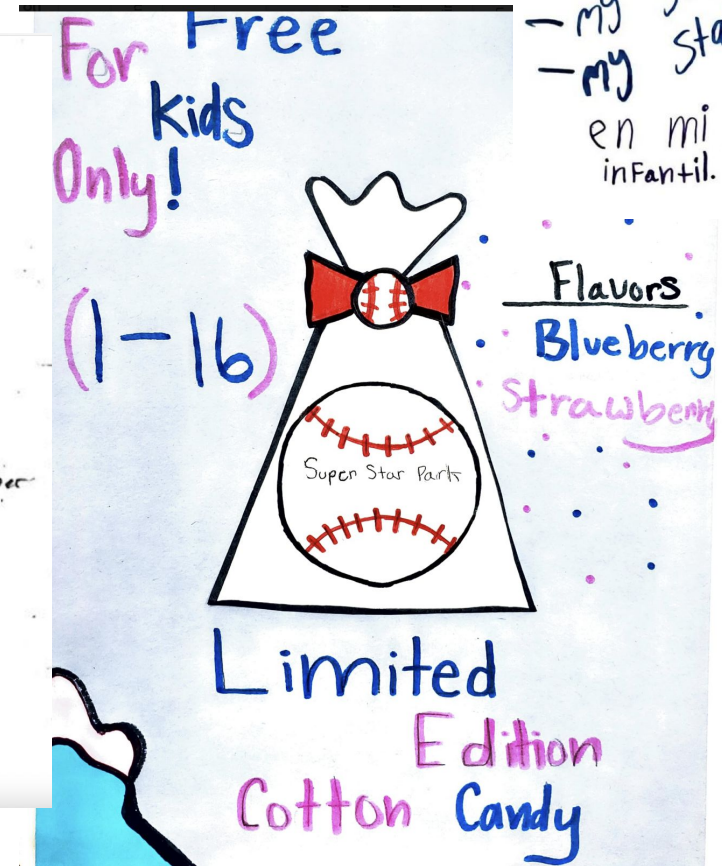


Design a Stadium



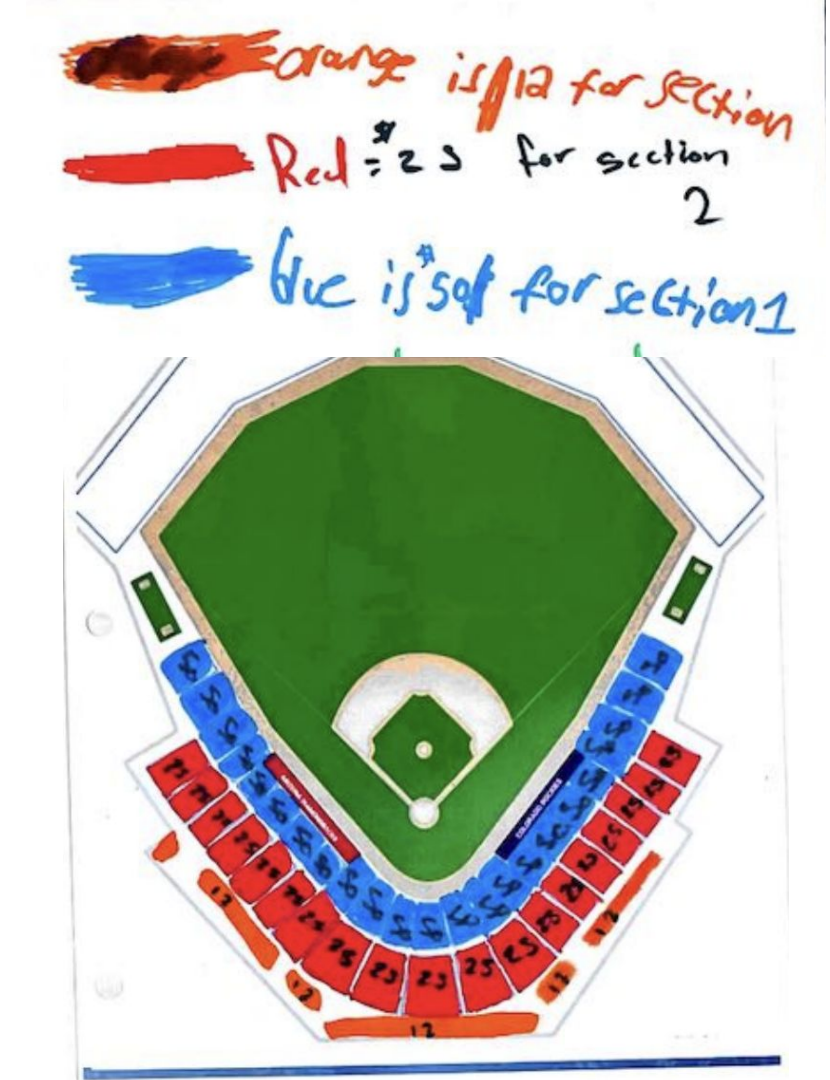
Sample Youth Posters
- Stadium Special Features





Design a Stadium

Sample Youth Poster
- Seating Plan & Ticket Prices

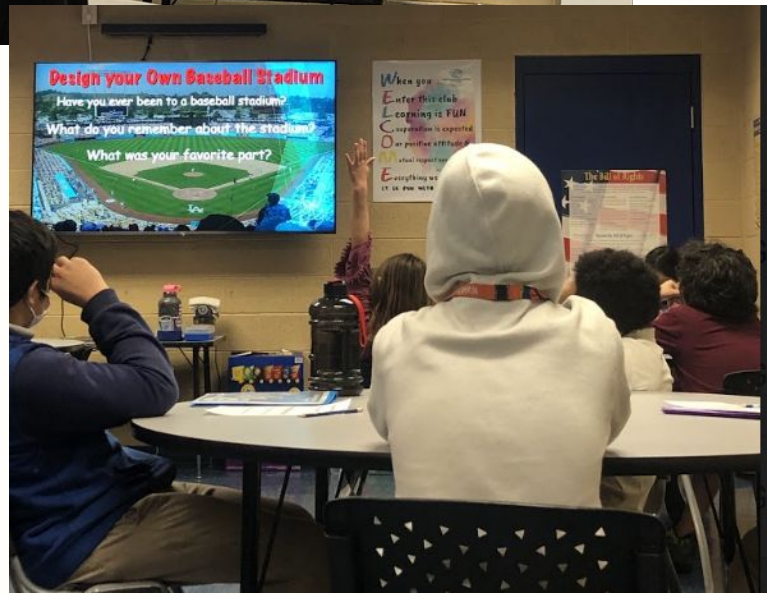


The total number of seats is 75,000
Seats for section 1 are 10,000
Seats for section 2 are 25,000
Seats for section 3 are 40,000

Design a Stadium

Data Sources

- Video recordings of small groups of youth as they work on performance-based tasks
- Researcher field notes
- Youth's final posters and planning work (worksheets, etc)



Research Questions Related to Youth Outcomes

How does participation in *Growing Mathletes* impact:

- **RQ 1. youths' mindset** related to athletic ability, and math/science learning?
- **RQ 2. youths' beliefs that support STEM learning,** including a) perceived relevance of/interest in math/science, and b) perceived competencies in math/science?
- **RQ 3. youths' understanding of targeted mathematics** concepts?

RQ1: Survey Results - Mindset related to math learning and athletic ability

Preliminary results shows that youth have strong growth mindset for overall learning pre which increases slightly pre to post

Growth mindset related to math is unchanged pre to post but remains high

Growth mindset related to athletic ability is unchanged pre to post

RQ1: Survey Results - Mindset related to math learning and athletic ability

Domain	Mean (s.d.) Pre	Mean (s.d.) Post
Overall growth mindset	4.37* (.77)	4.57 (.64)
STEM growth mindset	4.23 (.87)	4.10 (.93)
SEL growth mindset	3.25 (1.54)	3.21 (1.46)
SEL athletic growth mindset	3.34 (1.50)	3.38 (1.51)
Athletic growth mindset	4.48 (.73)	4.35 (.80)

$p < .05$, small effect size, $d = .3$

RQ2 Youth perceived relevance of/interest in math and b) perceived competencies in math

Preliminary results demonstrate that youth have a strong average interest in math - pre and post (~3.7 out of 4) and does not change significantly pre to post

There was a significant increase in youths' self-reported competency in STEM from pre to post implementation

Youth Interview Results

Analysis of 86 interviews produced consistent evidence of youth understanding of key math concepts.

Youth used experiential activities from the sessions to explain math ideas and described how tools used in the sessions supported their understanding.

Curriculum materials supported youth to engage in key math practices including organizing and labeling mathematical work, and facilitator prompts were key in supporting youth to communicate reasoning to others.

Lastly, many youth interviewed considered themselves to be math orientated and were able describe the relevance of math not only in sports but also in other parts of their lives.

Research Question Related to Facilitator Outcomes

RQ 5. What are the elements of effective professional development for informal STEM learning facilitators?

Includes:

- Facilitator learning outcomes
- Professional learning (PL) program and facilitator guide revisions
- Iterative testing of PL program with different facilitators/contexts

Preliminary Findings: Overview

Success and Supports:

- Facilitators show agency, make the curriculum their own, provide feedback
- Most identified learning occurs during initial training
- Facilitators understand content (math and mindset; baseball understanding mixed) and are confident in implementing

Remaining Challenges:

- Supporting time management during implementation; balancing baseball, math, and mindset concepts
- Adapting PL to diverse facilitator needs
- Providing timely supports and coaching through consecutive implementation dates (e.g., summer camps)

Key Concepts for Professional Learning Program (drawn from the literature)

- Educators should have opportunities to actively engage with the content as a learner
- Informal educators may need extra instructional and pedagogical support for effective STEM learning
- Professional learning for educators should include repeated cycles of learning, experience through enactment, and reflection
- Professional learning programs should be situated in the community of practice within the organization
- Hybrid professional learning environments should use virtual and in-person contexts to complement one another

Growth Mindset Concept	Astronomical Topics
1. *The value of collaboration.*	Contemporary astronomy projects require large and diverse teams.
2. *The power of effort and persistence.*	Catalina Sky Survey, astronomical discoveries
3. *The value of mistakes in supporting learning.*	How discoveries are made building on models that are often updated
4. *Malleability of the brain and the role of struggle in learning.*	Creativity and breakthroughs of discovery
5. *Praise the process, not the person.*	

Growth Mindset Concept	Informal Astronomy Activities
1. *The value of collaboration.*	Research experiences, collaborative projects, creations of complex projects
2. *The power of effort and persistence.*	Challenging activities, multi-day experiences, research experiences
3. *The value of mistakes in supporting learning.*	Give examples of historical figures who made mistakes and pushed the field forward - e.g. Galileo
4. *Malleability of the brain and the role of struggle in learning.*	Modeling productive struggle in writing and generating results
5. *Praise the process, not the person.*	Not about being the smartest - about how you persist.

Thank You!

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Figure 1. Theory of Action for Growing Mathletes