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RELATIONSHIPS MATTER

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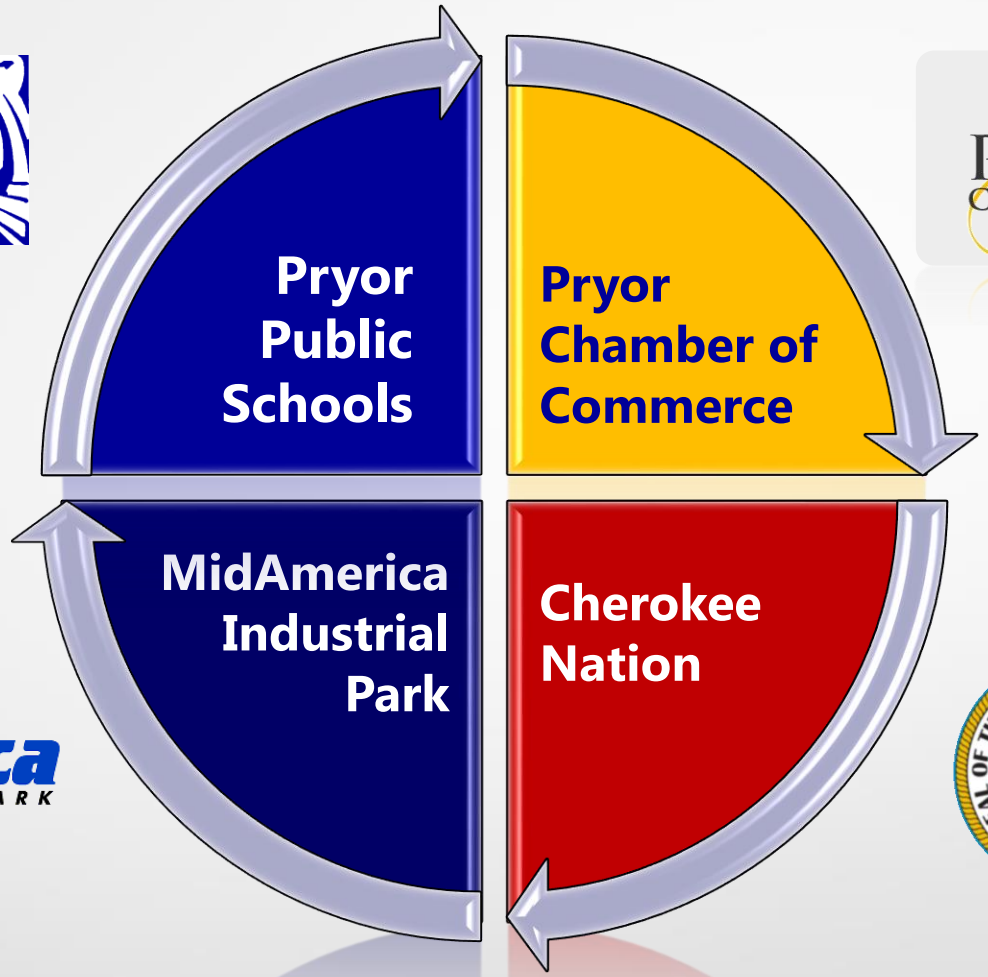

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SREB – ADVANCED ENGINEERING TECHNOLOGY

PRYOR PUBLIC SCHOOLS

INTEGRATED PRODUCTION TECHNOLOGY

COURSE DESCRIPTION

This course engages students in the use of modern technologies in the design and improvement of products. Students use three-dimensional CAD software in the creation and analysis process. Students document designs using standards set by industry for design documentation. Students implement methods of green production and just-in-time component supply, which allow for the lowest cost and highest quality products. Students design and troubleshoot data acquisition, programmable logic control, process monitoring, automation, and robotic systems. Students incorporate sensing and vision systems, utilizing cameras and sensors to control automated systems.

- Project 1: Reverse Engineering/Manufacturing Basics
- Project 2: Manufacturing's Role
- Project 3: Direct Current (DC) Motors
- Project 4: Thermoforming and Temperature Control
- Project 5: Tank Volume Control
- Project 6: Batch and Separation System

LEGO DUPLO Reverse Engineering

By Kira Weaver

INTRODUCTION

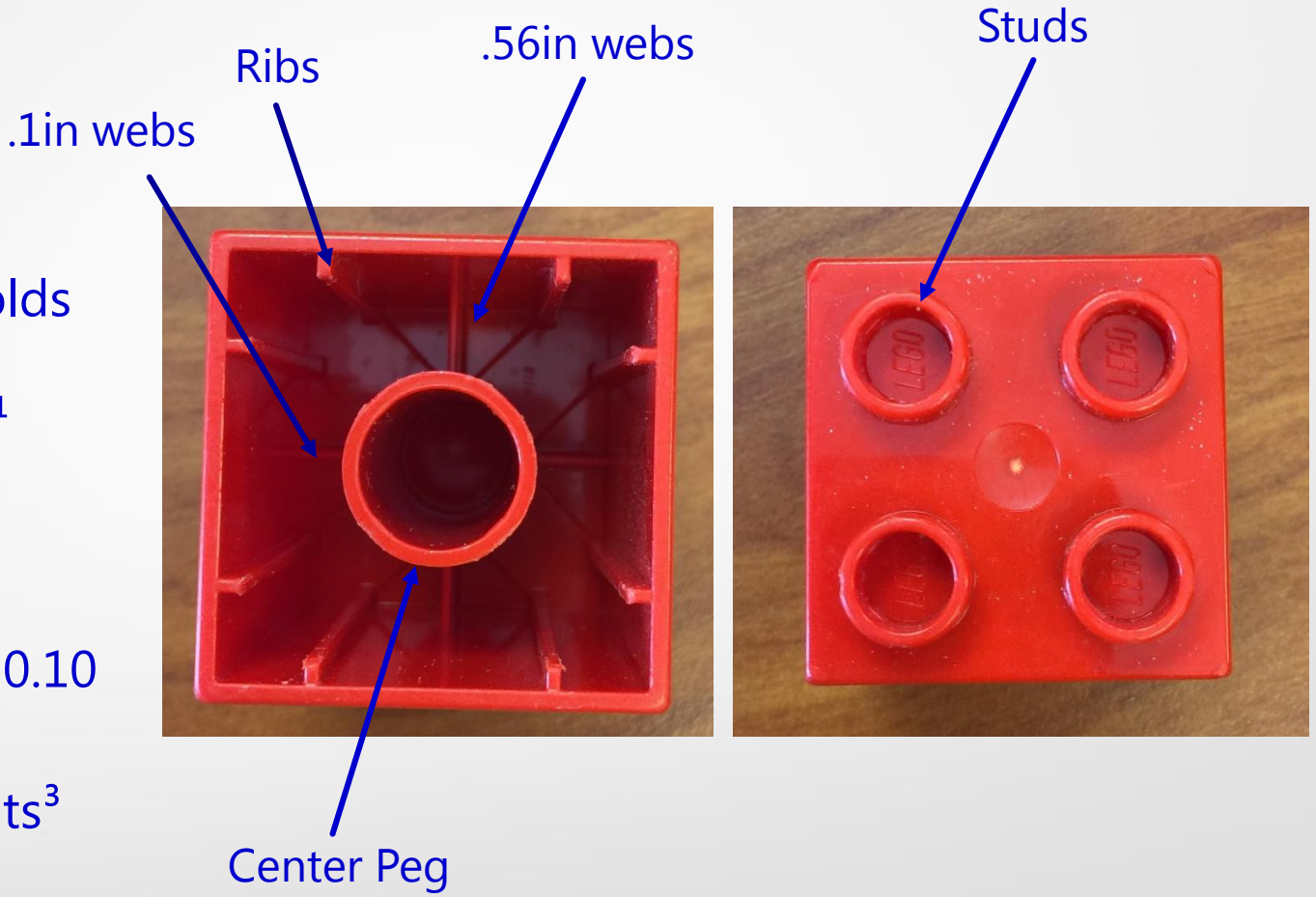
HomeTech Co. has requested an item be reverse engineered with clear documentation of the steps taken as well as a solid model. A Lego Duplo block was chosen for recreation.

- Item must fit within bounds of 3D printer's platform
- Project must stay under a set budget of $3,750
- Project must be completed by September 29, 2017

LITERATURE REVIEW

- Colored granules are melted
- Melted plastic is poured into molds
- Plastic is pressurized and cooled
- Blocks are removed from molds[1]

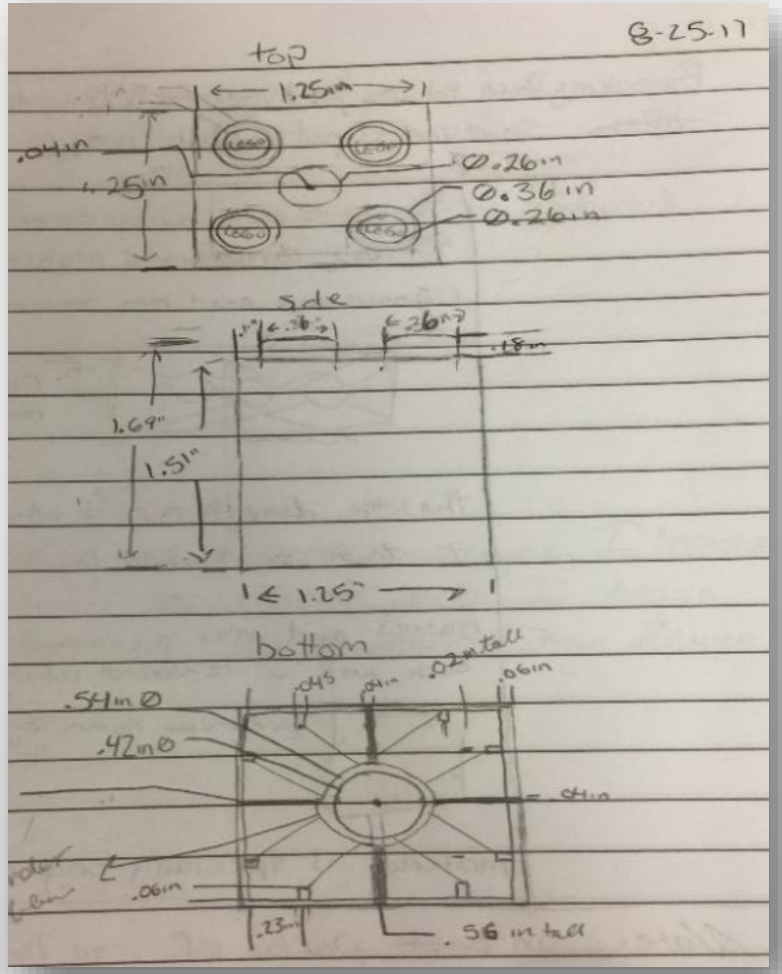
- Lego Duplo blocks cost less than $0.05 to manufacture
- Lego Duplo blocks sell for over $0.10 each[2]
- Blocks feature 5 main components[3]

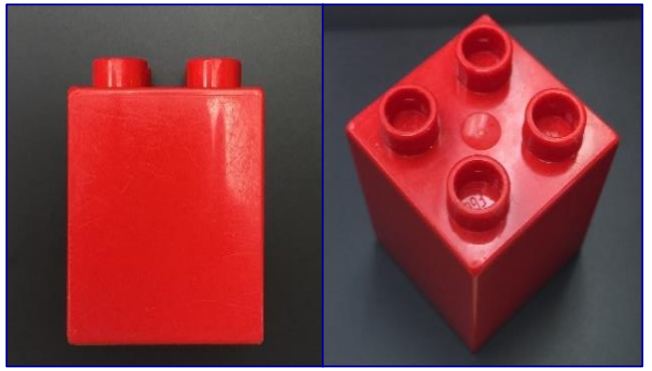


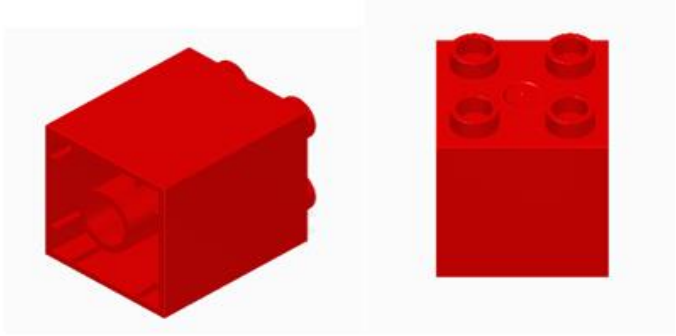
[1] lego.com/en-us/service/help/fun-for-fans/more-about-us/how-lego-bricks-are-made-408100000007834 [2] shop.lego.com/en-US/pickabrick
[3] shortsleeveandtieclub.com/breaking-down-the-design-lego-perfecting-the-plastic-brick

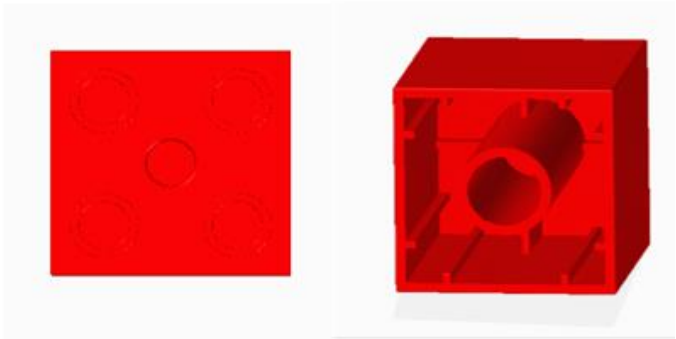
Creating a SolidEdge Model

The original Lego sample was measured and these measurements were displayed in technical drawings. These drawings were used to create a 3D SolidEdge model.









Test Print Results Chart

Test Print	Prototype	Results
1		**Test Print 1** • Printed stud side down • Printed less than half the size of original sample
2		**Test Print 2** • Resized to proper dimensions • Printed bottom (open) side down • One corner was raised
3		**Test Print 3** • Printed with no flaws
4		**Test Print 4** • Printed thicker than other blocks

Testing and Comparing Components

- Block must be 1.25 x 1.69 x 1.25 inches
- Block must have all 5 components shown in the original Lego sample
- Block must fit together with the Lego sample.

	Lego Duplo	Solid Model
Cost to Manufacture	$0.05	$0.77
Time to Manufacture	Less than 30 seconds	1 hour 40 minutes
Plastic Type	ABS	PLA
Error Rate	18/1,000,000	50% (out of 4 models only)

CONCLUSION

In all, the reverse engineering of the Lego Duplo block for HomeTech Co. was a success. However, reproduction of the blocks may not be reasonable for the future due to cost and time requirements.

The only change made to the blocks was lowering the center peg flush with the platform to allow the printer to build the models properly

Improvements that could be made to reduce costs include

- Use different material
- Use a different manufacturing method altogether

LEGO DUPLO Manufacturing Plan

Kira Weaver & Andrew Ramirez

PLANT TOUR OF AMERICAN CASTINGS

AMERICAN

THE RIGHT WAY

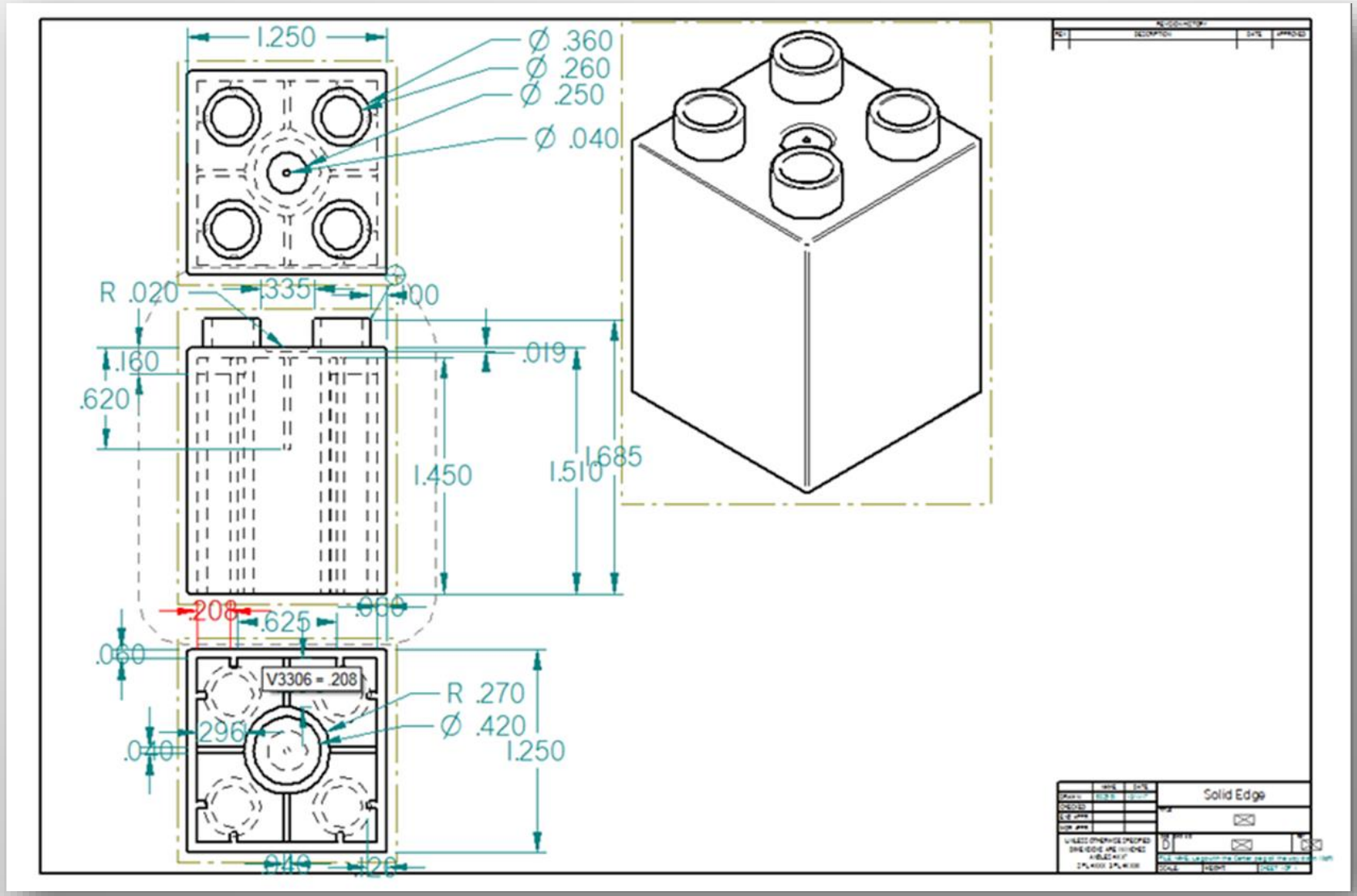
INTRODUCTION

LittleBugs Toy Company has hired a team of engineers to create a manufacturing plan for a new product

- New products modeled after Lego Duplo blocks
- Safety, cost-effectiveness, quality
- Budget of $155,300

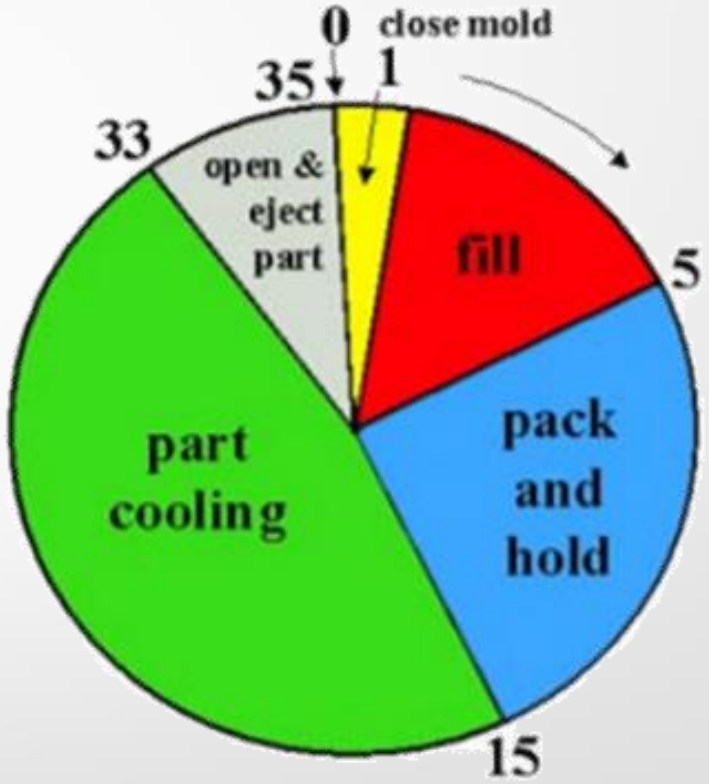
Parts and Materials		
Item	Quantity	Price per unit (USD$)
Injection Molding Machine	1	35,000
Silos	6	14,250
3D Scanner	1	25,000
Conveyor Belt	1	1,000
Production Sorter	1	3,790
Box Maker	1	5,000
Plastic Granules (1400lbs)	As needed	1,540

ORTHOGRAPHIC DRAWINGS



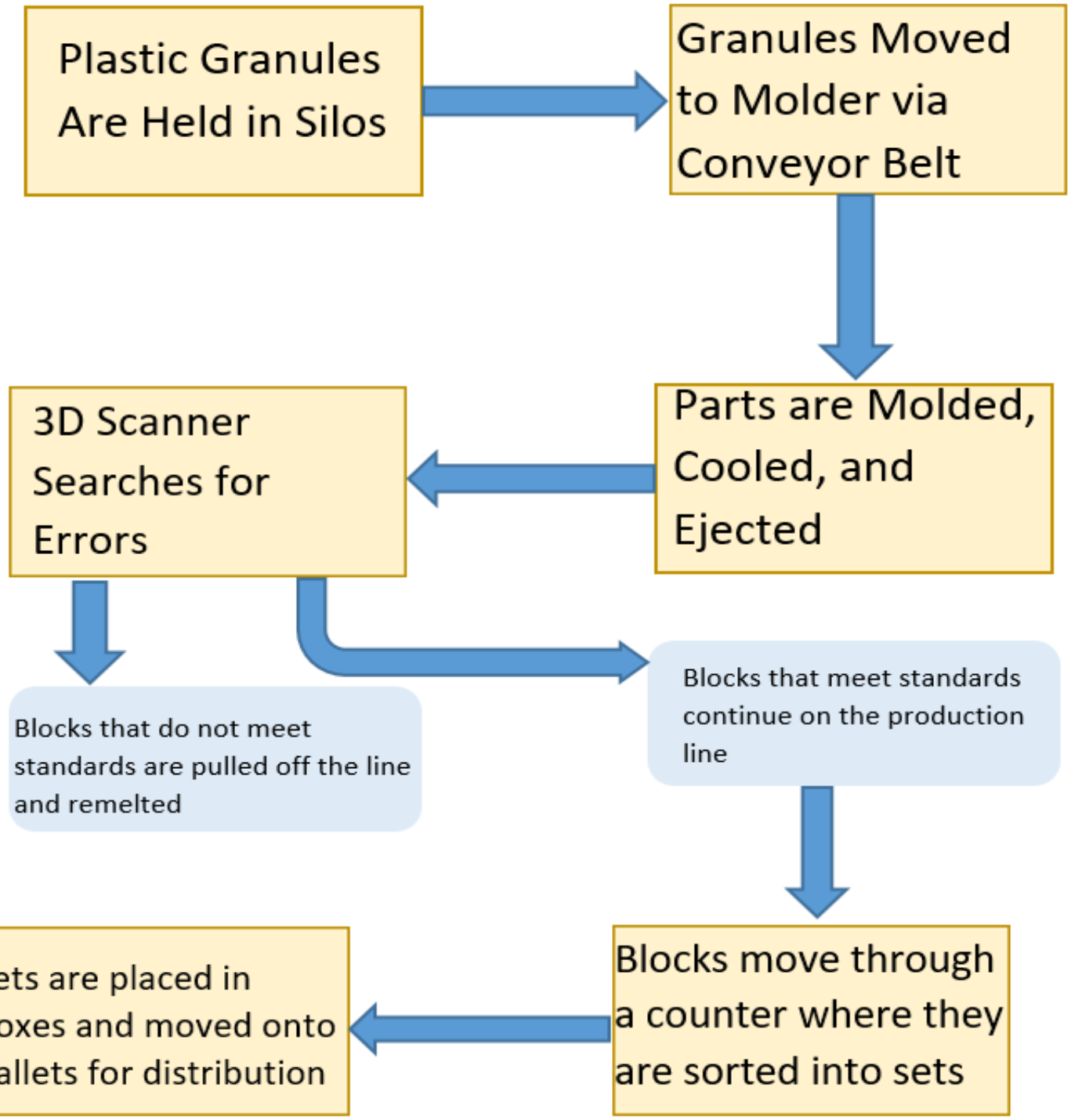
RESEARCH

- Polypropylene plastic was decided to be most appropriate plastic
  - Strength, safety, low cost, and eco-friendliness
- Injection molding was chosen as most reasonable manufacturing method
  - Relatively cheap process, fast manufacturing time



Plastic Choices				
Plastic Type	Cost per Pound (USD$)	Tensile Strength (psi)	Safety	Eco-Friendliness
HDPE	1.20	4000	Safe	Yes
PP	1.10	5400	Safe	Yes
PS	1.39	3500	Not Safe	No
ABS	1.29	4100	Safe	No

INJECTION MOLDING PROCESS



ROUTING SHEET

LittleBugs Building Blocks

Part Number: 197-187	Description: Block Set Production		Drawing No.: LPD-00100
Quantity: 50 "sets", 120 pcs	Mat: Polypropylene Plastic		Planner: K. Weaver
Revision No.: 001	Date: 10/12/17	Page 1 of 1	Order No.: RSN-0000-001

Op. no.	Description	Work Center	Machine
100	Granules moved to melting chamber and melted	Storage center	Silos
200	Melted plastic sent to molds	Warehouse	Injection Molding Machine
300	Molding machine pressurizes and cools the plastic	Warehouse	Injection Molding Machine
300	Blocks are ejected from the machine onto conveyor belt	" "	Injection Moldling Machine
400	Blocks are moved single-file into 3D scanner for quality	Warehouse	Conveyor Belt/3D Scanner
500	check, rejects are moved off production line	Warehouse	Conveyor Belt/3D Scanner
500	Blocks move through counter, sorted into sets	" "	Conveyor Belt/3D Scanner
600	Sets are reviewed, boxed, and prepared to distribute	Warehouse	Mechanical Counter
700		Warehouse/Shipping	Boxing Machine

SET PRODUCTION

Cost to Manufacture Building Blocks	
Est. Weight/ block: 13g Grams/Pound: Approx. 454	Grams/Pound / Weight/block = Blocks/pound 454g / 13g = Approx 34
1 Pound/PP: $1.10 Blocks/Pound: 34	Pound/PP / Blocks/Pound = Cost/Block 1.10 / 34 = $.03
Cost/Block: $.03 Blocks/set: 120	Cost/Block x Blocks/Set = Cost/Set $.03 x 120 = $3.60

LittleBugs Building Blocks

Assembly Name : Building Blocks Set
Assembly Number : 1
Assembly Revision : 1
Approval Date : 10-Oct-17
Part Count : 120
Total Cost : $3.60

Part #	Part Name	Description	Qty	Units	Picture	Unit Cost	Cost
1	Building block	Color: Red Material: PP	20	each		$0.03	$ 0.60
2	Building block	Color: Blue Material: PP	20	each		$ 0.03	$ 0.60
3	Building block	Color: Yellow Material: PP	20	each		$ 0.03	$ 0.60
4	Building block	Color: White Material: PP	20	each		$ 0.03	$ 0.60
5	Building block	Color: Orange Material: PP	20	each		$ 0.03	$ 0.60
6	Building block	Color: Green Material: PP	20	each		$ 0.03	$ 0.60
	Total		120				$ 3.60

CONCLUSION

- Researched manufacturing methods and created a budget
- Created a manufacturing process as well as supplemental documents
  - Bill of Materials, orthographic drawings, routing sheets
- Possible improvements:
  - White filaments, add in color pigment during melting
  - Combine 3D scanner and mechanical counter

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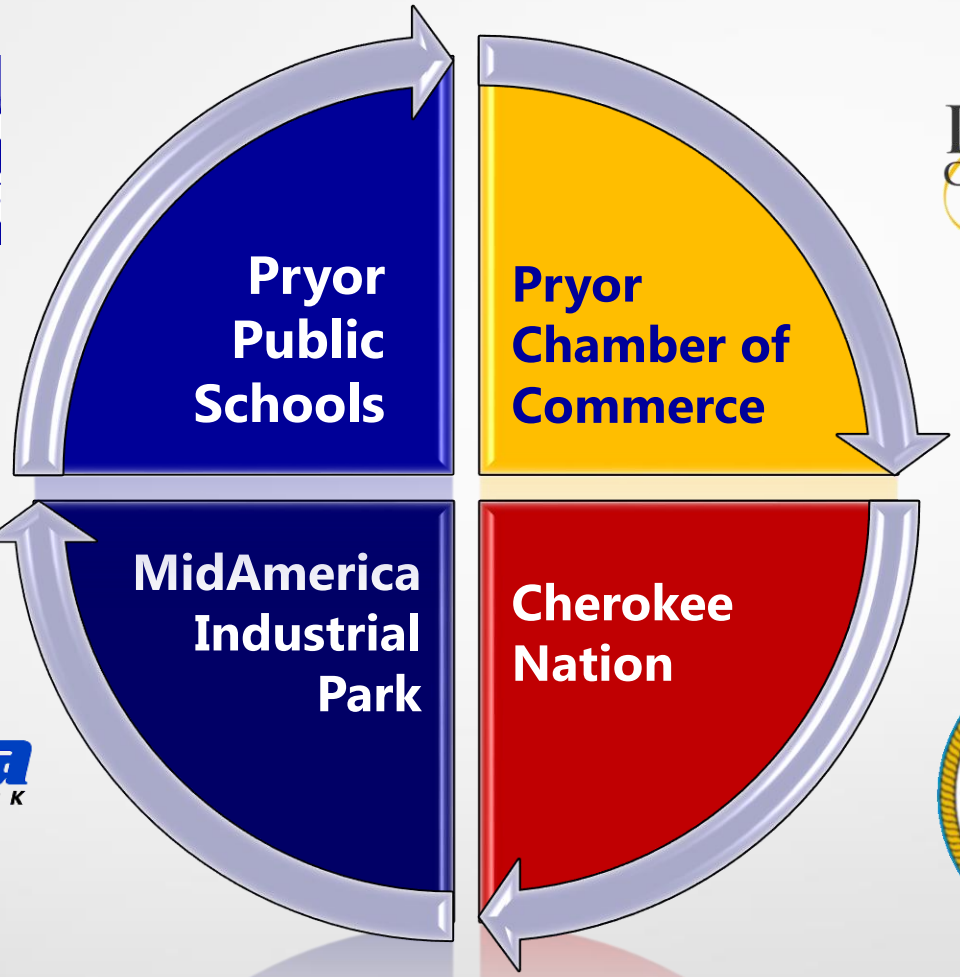

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Donated funding to support STEM Labs for the 5 Mayes County Schools

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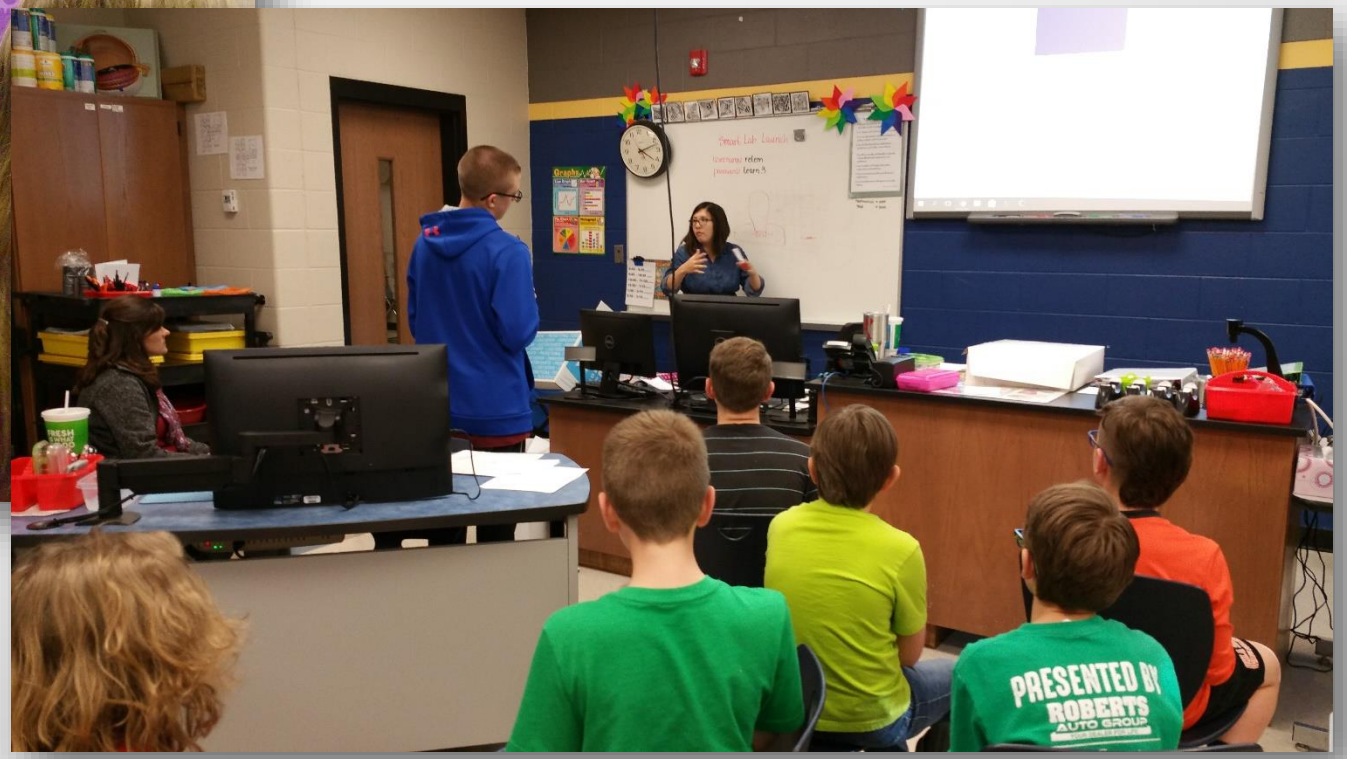

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TIGER PRIDE
Pryor Robotics Innovative Determined Engineers

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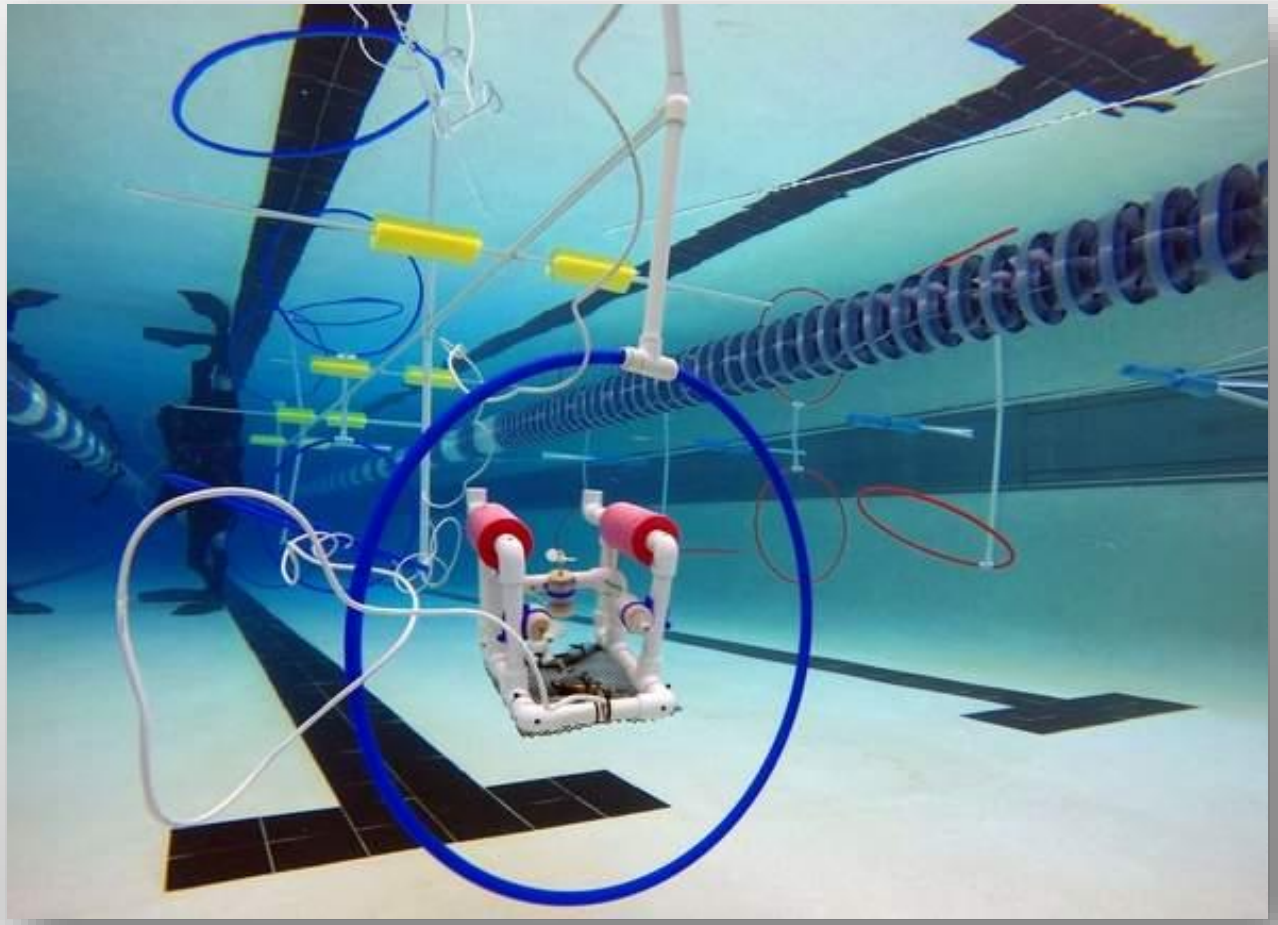

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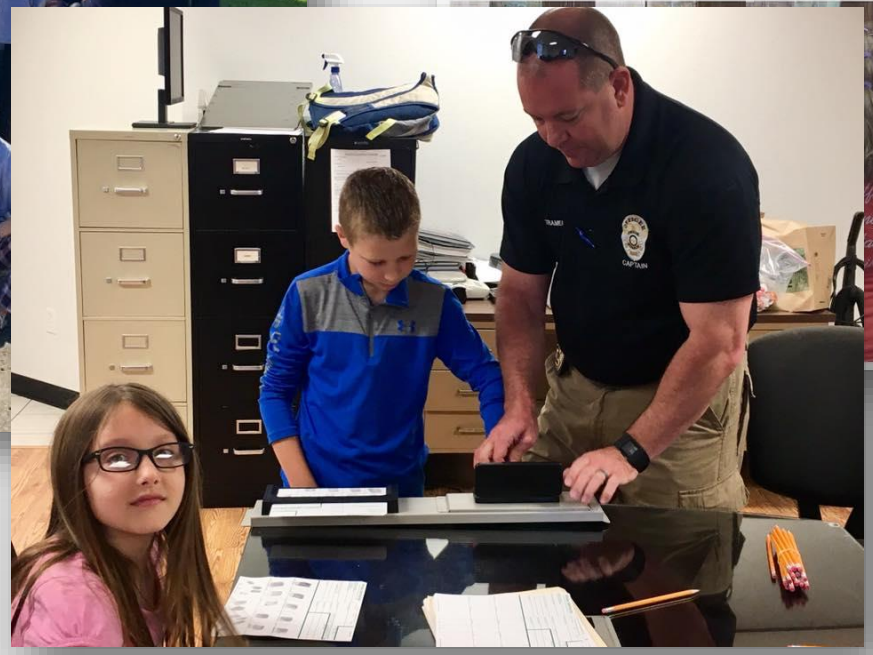
3rd GRADERS GO TO WORK

PRYOR AREA CHAMBER OF COMMERCE



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