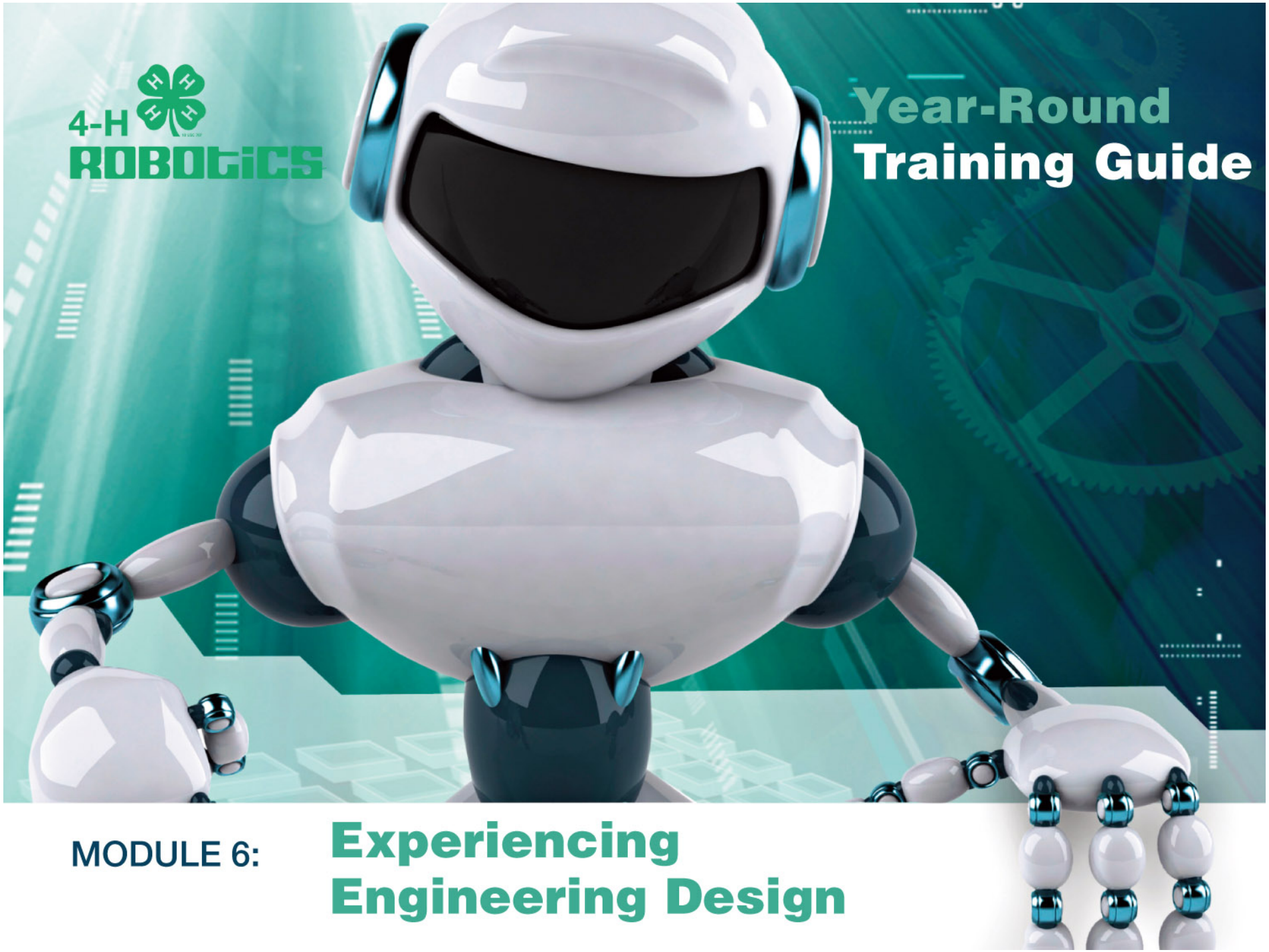
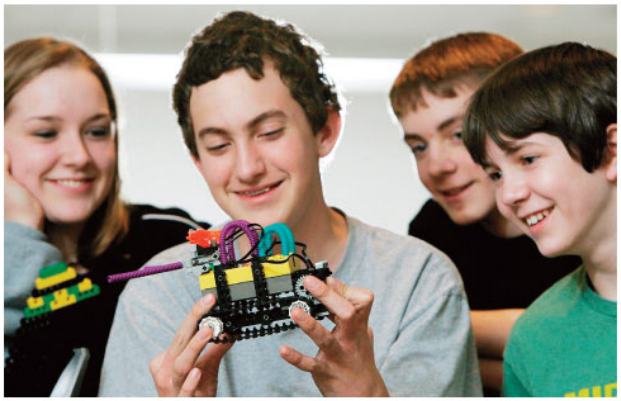


MODULE 6:

Experiencing Engineering Design

4-H Robotics: Engineering for Today and Tomorrow



18 USC 707

4-H Robotics Curriculum

4-H Robotics Introduces Youth to:

- Basic physical science concepts related to robotic systems
- The Scientific Inquiry Process
- The Engineering Design Process
- Technology tools for learning and communications
- An exploration of SET careers

4-H Robotics Curriculum

- ***Virtual Robotics:*** Youth utilize an interactive computer game environment to learn about the science and engineering of robots.
- ***Junk Drawer Robotics:*** Youth make use of everyday objects to design, build and learn about robots.
- ***Robotics Platforms:*** Youth employ robotics kits to understand robotics and programming and develop their own robot designs.

MODULE 6: **Experiencing Engineering Design**

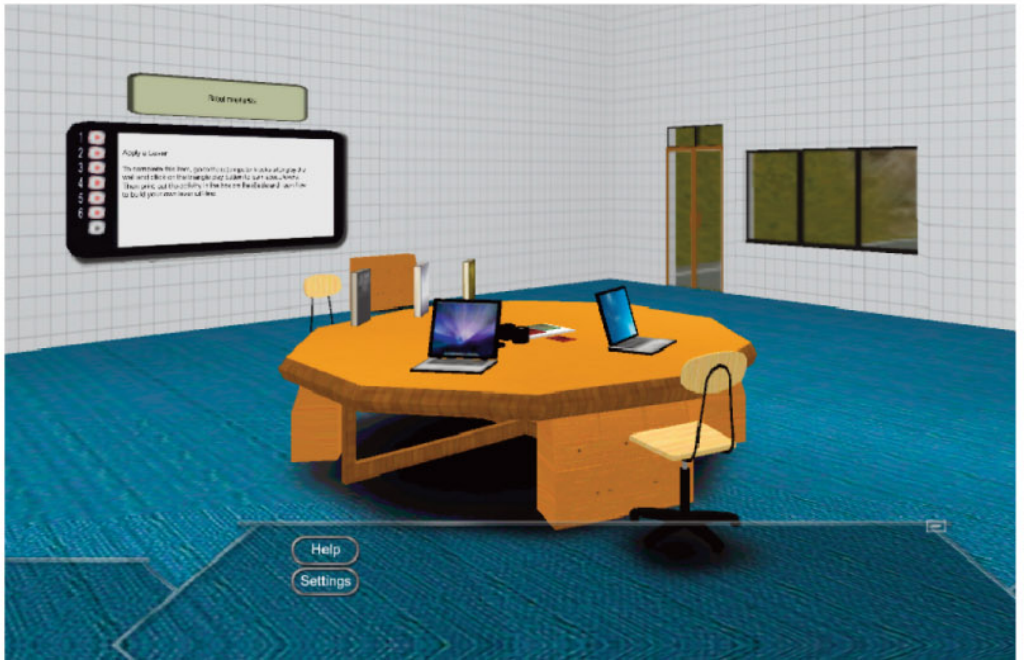
4-H ROBOTICS

Track 1: Virtual Robotics

Youth build skills and knowledge about robotics as they play an interactive computer game.

The learning experience includes videos, simulations, and animations—all in an interactive virtual robotics lab.

Curriculum is delivered on a DVD.



MODULE 6: **Experiencing Engineering Design**

4-H ROBOTICS

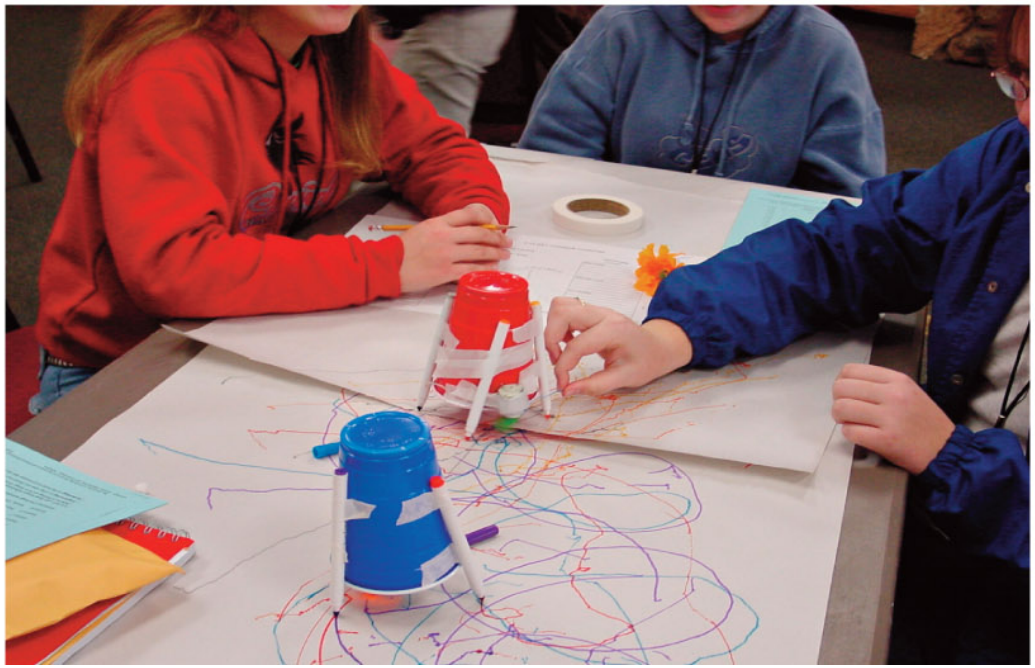
Track 2: Junk Drawer Robotics

Youth design, construct and test robots that lift, move or float.

Each level focuses on one aspect of robotics and the science, engineering and technology behind it.

Designed to be a teen-led program.

Curriculum includes three printed Presenter's Guides and a Youth Robotics Notebook.



MODULE 6: **Experiencing Engineering Design**

4-H ROBOTICS

Track 3: Robotics Platforms

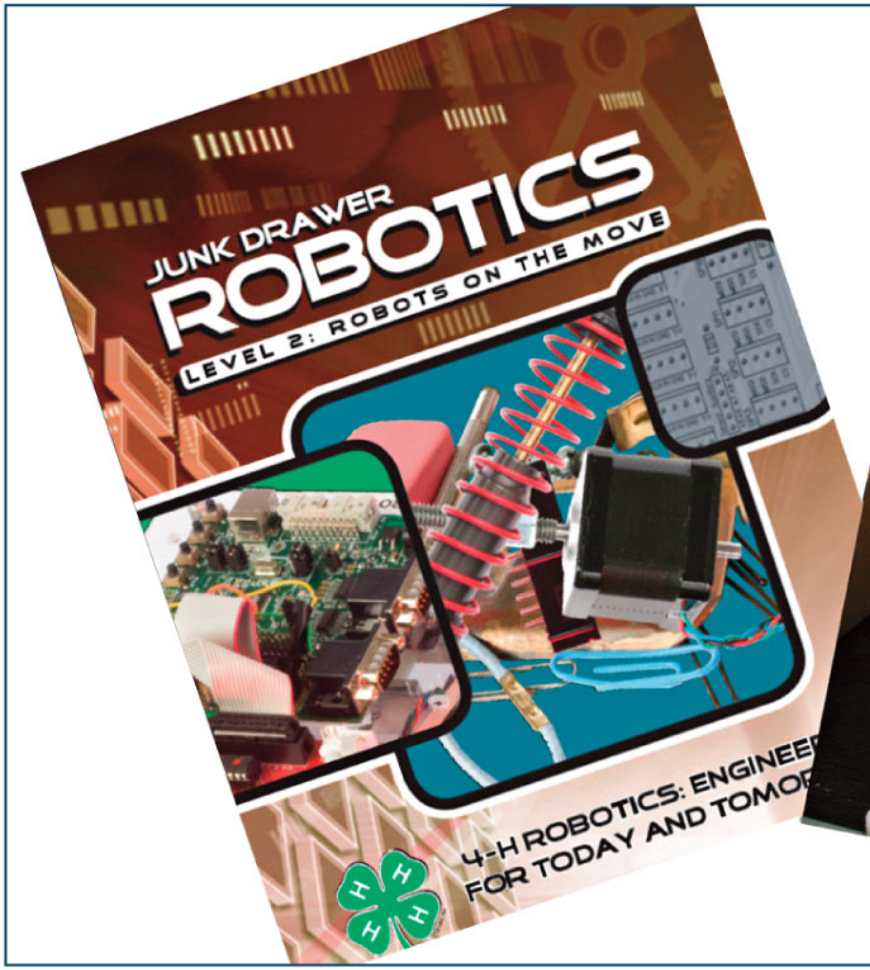
Youth apply the engineering processes of designing, building and programming robots.

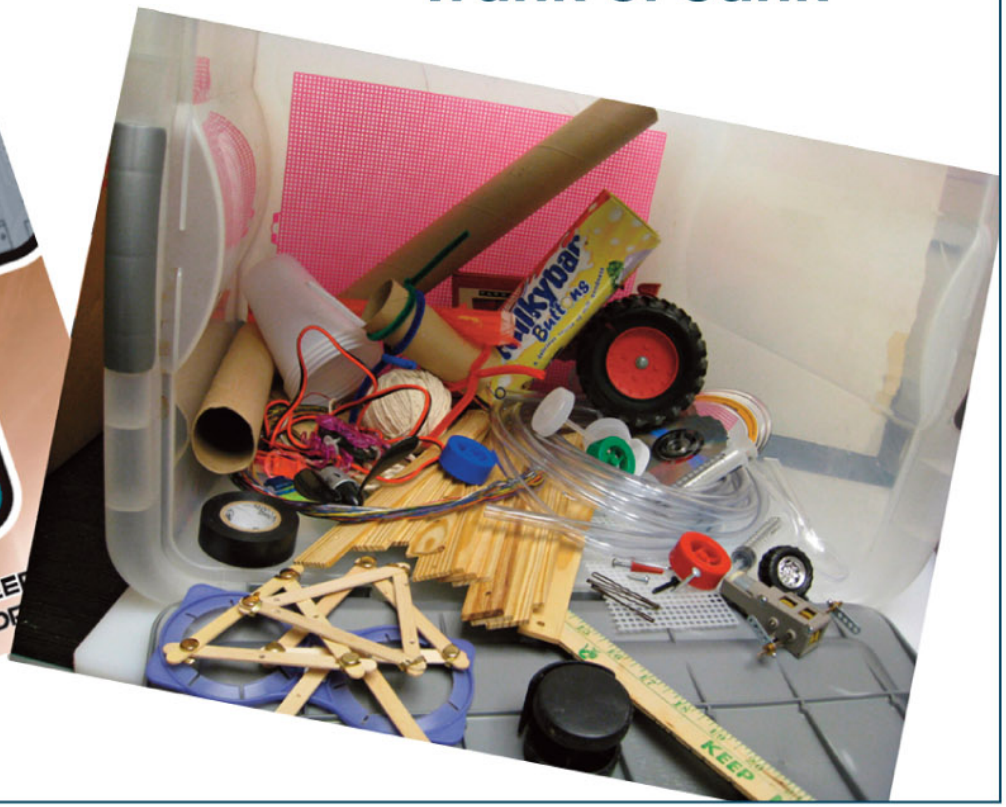
Youth build skills and knowledge and apply what they have learned to a challenge activity.

Curriculum is delivered on a DVD.

Makes use of a commercial robotic kit such as LEGO® MINDSTORMS®, VEX®, TETRIX® or CEENBoT™.

Junk Drawer Robotics





To Learn, To Do, To Make

Module 1: Get Things Rolling

Overview of Activities in this Module

To Learn

Activity A – Slip N Slide
Activity B – Rolling Along

To Do

Activity C – Clipmobile Design Team

To Make

Activity D – Clipmobile Build Team

Note to Leader

When two people don't seem to get along, we say there is friction between them. What is friction? In

up a hill? Sometimes we need to both reduce and increase friction.

Uses of friction in everyday life can be seen when we walk or ride in a car. Have you slipped in spilled water, or on ice? Have you seen a car spin around

To Learn:

Activity A: Slip N Slide

4-H Robotics:
Engineering for Today and Tomorrow
Robotics Notebook

Date _____

Signature _____

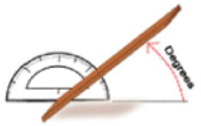
To Learn

Activity A – Slip N Slide

Test sliding the box of paper clips on the control section of plain cardboard and then on slick tape, sandpaper, and other surfaces for comparisons.

Test by slowly raising the angle of the cardboard ramp until the box of paper clips begins to slide down the ramp.

Measure the angle at which the box of paper clips begins to move. Repeat to get an average angle.



Predictions

Which surface will have the least friction?

1 _____

2 _____

3 _____

4 _____

Surface	Test #	Angle when box began to move
Control Surface	#1	
Plain Cardboard Ramp	#2	
	#3	
Surface A	#1	
	#2	
	#3	
Surface B	#1	
	#2	
	#3	
Surface C	#1	
	#2	
	#3	
Surface D	#1	
	#2	
	#3	

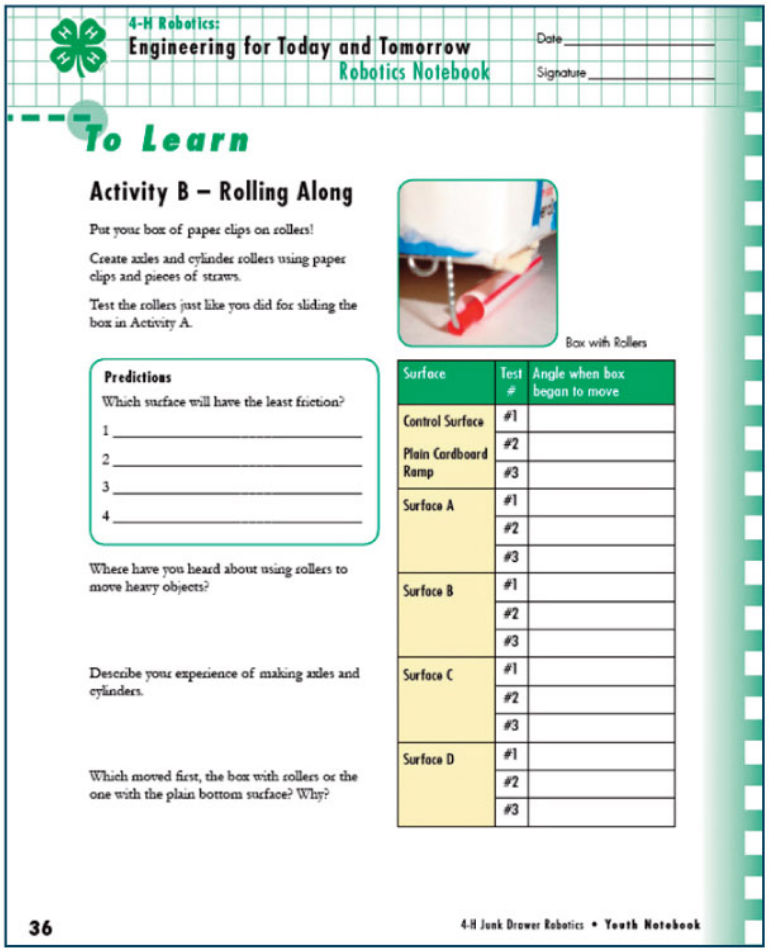
What had the greatest effect on friction?

Why do you think it's important to repeat the same experiment?

Why is it important to do a control?

To Learn:

Activity B: Rolling Along



4-H Robotics:
Engineering for Today and Tomorrow
Robotics Notebook

Date _____
Signature _____

To Learn

Activity B – Rolling Along

Put your box of paper clips on rollers!

Create axles and cylinder rollers using paper clips and pieces of straws.

Test the rollers just like you did for sliding the box in Activity A.

Box with Rollers

Predictions

Which surface will have the least friction?

1 _____
2 _____
3 _____
4 _____

Where have you heard about using rollers to move heavy objects?

Describe your experience of making axles and cylinders.

Which moved first, the box with rollers or the one with the plain bottom surface? Why?

Surface	Test #	Angle when box began to move
Control Surface	#1	
Plain Cardboard Ramp	#2	
	#3	
Surface A	#1	
	#2	
	#3	
Surface B	#1	
	#2	
	#3	
Surface C	#1	
	#2	
	#3	
Surface D	#1	
	#2	
	#3	

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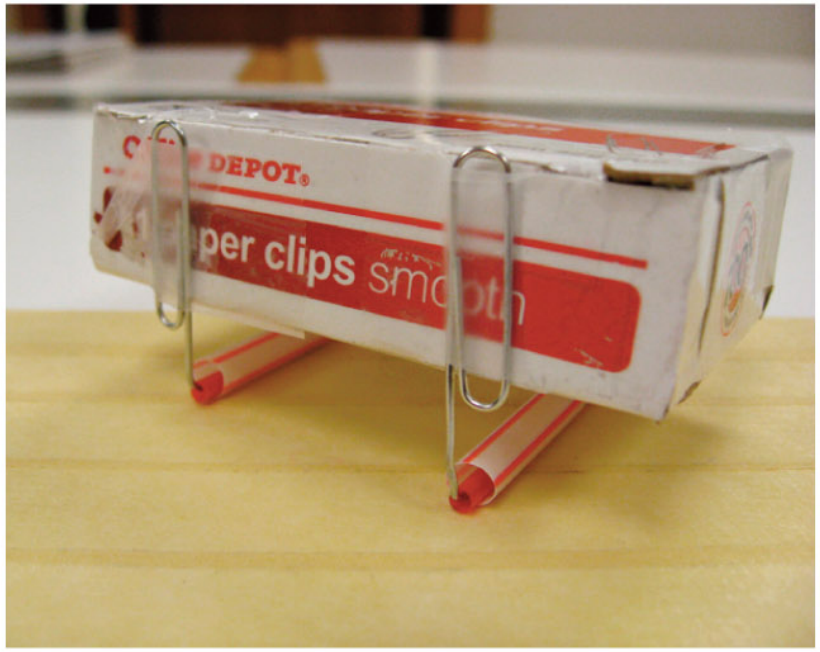
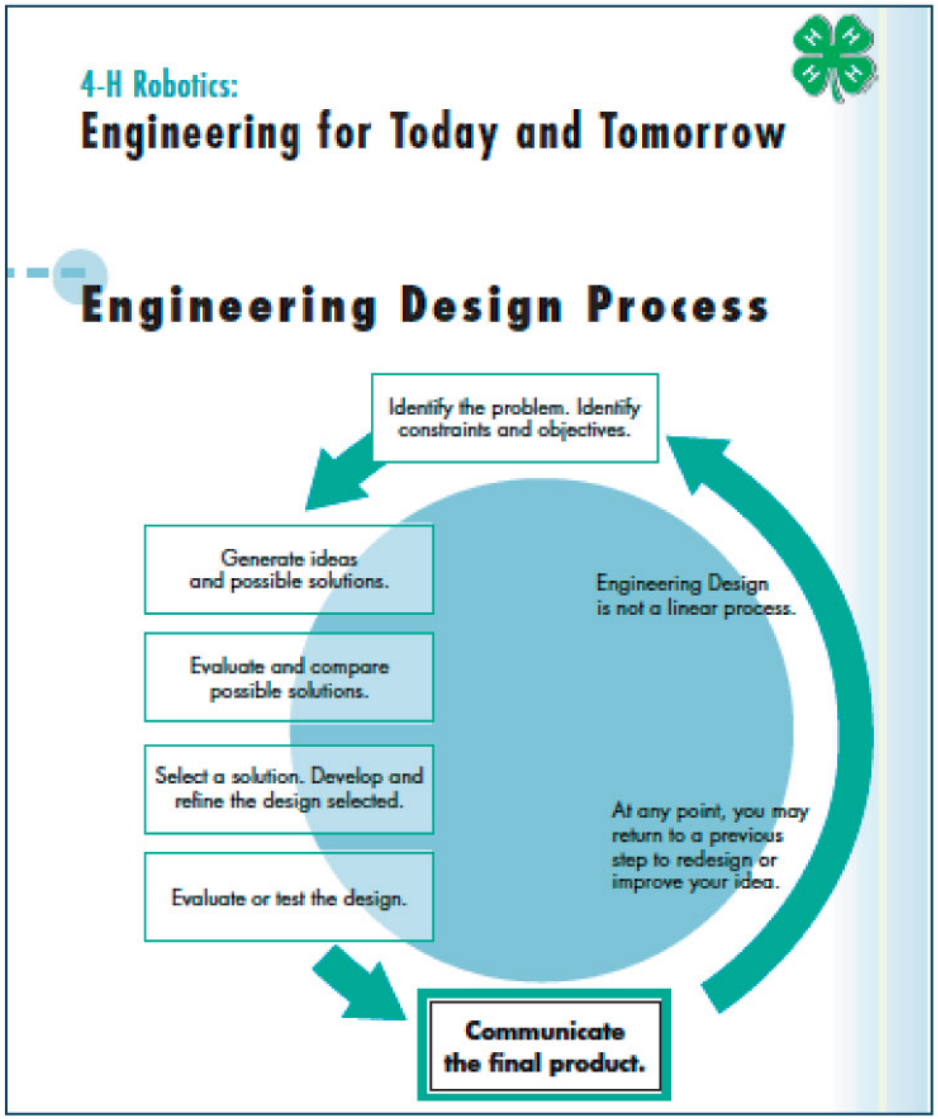
4-H Junk Drawer Robotics • Youth Notebook



Engineering Design Process



Junk Drawer Robotics

Activity C – Clipmobile Design Team

Performance Task For Youth

You will plan and design a vehicle to maximize its ability to coast, based on considering the effects of friction. You also will consider constraints of capacity, efficiency, complexity, and costs in the design.

Success Indicator

Youth will design a vehicle that will roll easily and meet the constraints listed.

List of Materials Needed

- Robotics Notebook
- Activity Supplies
  - A bag of "start-up" sample supplies for each Design Team. One each of the following is suggested:
    - One regular craft stick, one jumbo craft stick, one craft stick with holes
    - One regular paper clip, one large paper clip
    - One 1-inch paper brad, one 1 ½-inch paper brad
    - One binder clip

Activity Timeline and Getting Ready

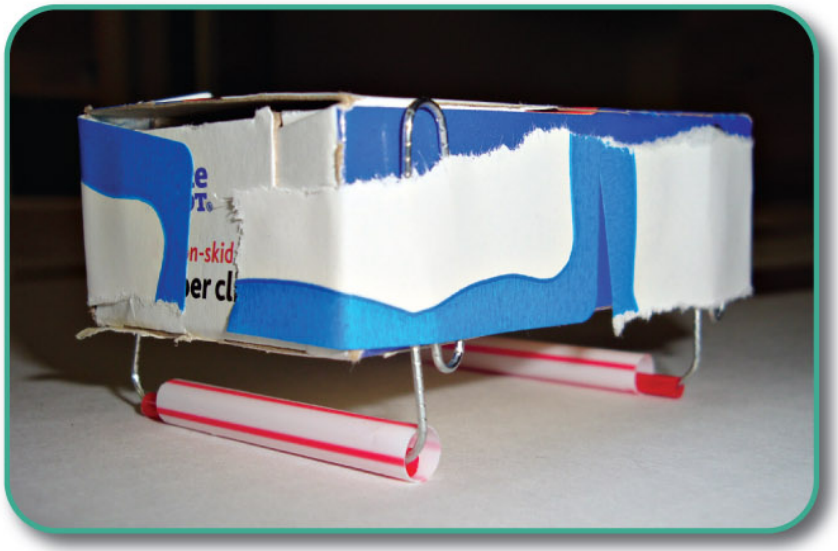
- Activity will take approximately 20 minutes.
- Divide youth into groups of two or three.
- Print some fake paper money for students to use.
- If not using the Robotics Notebook, make copies of the Clipmobile Challenge, the Junk Drawer Supply Company sheet, and the Materials Order Form.
- Assemble packs of start-up materials for each group.
  - Fill a re-sealable bag with some materials that can be used in building the

- To Learn
- **To Do**
- To Make

Robots on the Move

Clipmobile Design Objectives

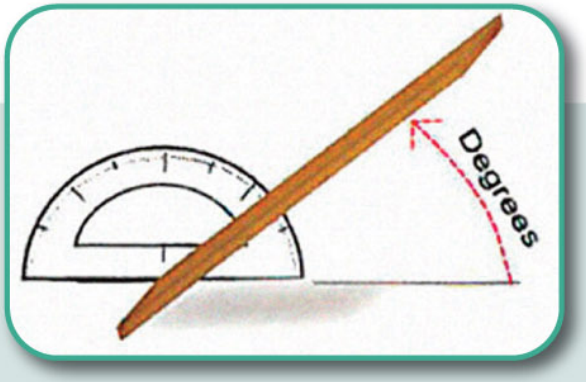
Design a vehicle that will roll easily and meet the customer requirements and constraints.



Robots on the Move

Customer Requirements for Clipmobile

- Design a vehicle that will overcome friction and roll freely down a ramp, and travel a long distance (performance).
- It must be able to hold (carry) a box of paper clips (capacity).



Robots on the Move

Customer Requirements for Clipmobile

- It must contain at least five different types of parts (complexity).
- But it must use the least total number of all parts (efficiency).
- Cost of Production target is to be $35 or less for producing your design. You will have $45 to create your prototype.

4-H Robotics:
Engineering for Today and Tomorrow
Robotics Notebook

Date _____

Signature _____

To Do

Activity C – Clipmobile Design Team

Customer Requirements for a Clipmobile:

- Design a vehicle that will overcome friction and roll freely down a ramp, and travel a long distance. (performance)
- It must be able to carry a box of paper clips. (capacity)
- It must contain at least five different types of parts. (complexity)
- It must use the least total number of all parts. (efficiency)
- Cost target is to be no more than $35.00 of play money, including start-up supplies in inventory bag. (budgeting)

Manufacturing Selection Criteria

Criteria to select the team that will be chosen to mass produce the Clipmobile:

Meeting Design Criteria (constraints)

Capacity – carry a box of paper clips:	(Yes) 10 points; (No) 0 points	_____
Performance – roll down ramp and coast:	+1 point per inch – maximum 24 points	_____
Complexity – various types of parts used:	+2 points for each type of part	_____
Efficiency – least overall number of parts:	-1 point for each part used	_____
Budget/cost – cost of production:	+1 point for each dollar under $35.00	_____
	-2 points for each dollar over $35.00	_____

Team Business Strength

Capital – dollars left from $45.00	+1 point for each dollar still in cash	_____
Inventory value – value of supplies in inventory	+1 point for each dollar of value	_____
	Overall Team Score	_____

Robots on the Move

(Page 38)

Junk Drawer Supply Company Clipmobile Materials Order Form (MOF)				
	Sold to: _____			Order Date _____
Item Code #	Item/Part Description	Price per Item	Number Ordered	Total Cost (Price X Number)
101	**Craft Stick –** Large or small	$3.00		
102	**Craft Stick** *w/ holes* **–** Large or small	$4.00		
203	**Paper Clip –** Large or small	$1.00		
304	**Brass Paper Brad –** Various sizes	$1.00		
405	**Binder Clip –** Various sizes	$2.00		
506	**Drinking Straw –** Various sizes	$2.00		
507	**Coffee Stirrer Straw**	$1.00		
608	**Rubber Band –** Various sizes	$1.00		
709	**Wheel –** Various sizes	$3.00		
810	**Wood Skewer –** Various sizes	$2.00		
Thanks for using **Junk Draw Supply Company.** See us first for all your robot supplies!			**Grand Total:**	

Robots on the Move

Materials Order Form

(Page 39)

Robots on the Move

Cost of Production

Clipmobile Report
Cost of Production (COP)

Date of Production: _____ Location of Mfg.: _____ Manufactured by: _____

Item Code #	Item/Part Description	Price Per Item	Number Used in Vehicle*	Total Cost (Price X Number)	Check Items Used in This Build
101	Craft Stick – Large or small	$3.00			
102	Craft Stick *w/ holes* – Large or small	$4.00			
203	Paper Clip – Large or small	$1.00			
304	Brass Paper Brad – Various sizes	$1.00			
405	Binder Clip – Various sizes	$2.00			
506	Drinking Straw – Various sizes	$2.00			
507	Coffee Stirrer Straw	$1.00			
608	Rubber Band Various sizes	$1.00			
709	Wheel – Various sizes	$3.00			
810	Wood Skewer – Various sizes	$2.00			
*include full value even if only part of an item was used, cut in half, taken apart, etc.		Totals			
			Total Parts Used	Total Cost of Production	Total Parts Used

(Page 41)

Materials Inventory Sheet

Clipmobile Report
Materials Inventory Sheet (MIS)
List of supplies left over and in good condition

For office use only

Date of Inventory: _____ Location of Mfg.: _____ Name of Manufacturer: _____

Item Code #	Item/Part Description	Used Value Per Item	Number of Good Items Still on Hand*	Total Value (Price X Number)	Verification of Inventory on Hand
101	Craft Stick – Large or small	$1.50			
102	Craft Stick *w/ holes* – Large or small	$2.00			
203	Paper Clip – Large or small	$0.50			
304	Brass Paper Brad – Various sizes	$0.50			
405	Binder Clip – Various sizes	$1.00			
506	Drinking Straw – Various sizes	$1.00			
507	Coffee Stirrer Straw	$0.50			
608	Rubber Band Various sizes	$0.50			
709	Wheel – Various sizes	$1.50			
810	Wood Skewer – Various sizes	$1.00			
*only include complete items in good usable condition; not those cut, drilled, bent, taken apart, etc.		Totals			
			Total Parts Not Used	Total Value of Parts on Hand (Inventory)	

(Page 42)

Robots on the Move

Manufacturing Selection Criteria

Criteria to select the team that will be chosen to mass produce the Clipmobile:

Meeting Design Criteria (constraints)

Capacity – carry a box of paper clips:	(Yes) 10 points; (No) 0 points	_____
Performance – roll down ramp and coast:	+1 point per inch – maximum 24 points	_____
Complexity – various types of parts used:	+2 points for each type of part	_____
Efficiency – least overall number of parts:	-1 point for each part used	_____
Budget/cost – cost of production:	+1 point for each dollar under $35.00	_____
	-2 points for each dollar over $35.00	_____

Team Business Strength

Capital – dollars left from $45.00	+1 point for each dollar still in cash	_____
Inventory value – value of supplies in inventory	+1 point for each dollar of value	_____
	Overall Team Score	_____

Evaluating Designs

Selection Criteria

Manufacturing Selection Criteria

Criteria to select the team that will be chosen to mass produce the Clipmobile:

Meeting Design Criteria (constraints)

Capacity – carry a box of paper clips:	(Yes) 10 points; (No) 0 points	_____
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Complexity – various types of parts used:	+2 points for each type of part	_____
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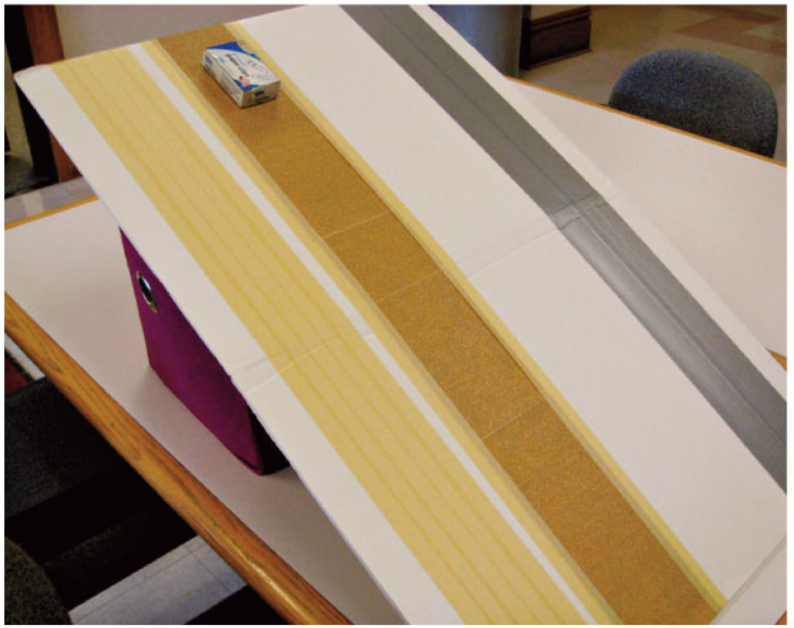
Budget/cost – cost of production:	+1 point for each dollar under $35.00	_____
	-2 points for each dollar over $35.00	_____

Team Business Strength

Capital – dollars left from $45.00	+1 point for each dollar still in cash	_____
Inventory value – value of supplies in inventory	+1 point for each dollar of value	_____
	Overall Team Score	_____

Capacity and Performance



Evaluating Designs

Selection Criteria

Manufacturing Selection Criteria

Criteria to select the team that will be chosen to mass produce the Clipmobile:

Meeting Design Criteria (constraints)

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	-2 points for each dollar over $35.00	_____

Team Business Strength

Capital – dollars left from $45.00	+1 point for each dollar still in cash	_____
Inventory value – value of supplies in inventory	+1 point for each dollar of value	_____
	Overall Team Score	_____

Complexity, Efficiency and Budget

Clipmobile Report

Cost of Production (COP)

Date of Production: _____ Location of Mfg.: _____ Manufactured by: _____

Item Code #	Item/Part Description	Price Per Item	Number Used in Vehicle*	Total Cost (Price X Number)	Check Items Used in This Build
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709	**Wheel** – Various sizes	$3.00			
810	**Wood Skewer** – Various sizes	$2.00			
*include full value even if only part of an item was used, cut in half, taken apart, etc.		**Totals**			
			Total Parts Used	**Total Cost of Production**	**Total Parts Used**

Evaluating Designs

Selection Criteria

Manufacturing Selection Criteria

Criteria to select the team that will be chosen to mass produce the Clipmobile:

Meeting Design Criteria (constraints)

Capacity – carry a box of paper clips:	(Yes) 10 points; (No) 0 points	_____
Performance – roll down ramp and coast:	+1 point per inch – maximum 24 points	_____
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Budget/cost – cost of production:	+1 point for each dollar under $35.00	_____
	-2 points for each dollar over $35.00	_____

Team Business Strength

Capital – dollars left from $45.00	+1 point for each dollar still in cash	_____
Inventory value – value of supplies in inventory	+1 point for each dollar of value	_____
	Overall Team Score	_____

Capital and Inventory

Clipmobile Report

Materials Inventory Sheet (MIS)

List of supplies left over and in good condition

For office use only

Date of Inventory: _____ Location of Mfg.: _____ Name of Manufacturer: _____

Item Code #	Item/Part Description	Used Value Per Item	Number of Good Items Still on Hand*	Total Value (Price X Number)	Verification of Inventory on Hand
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608	**Rubber Band** Various sizes	$0.50			
709	**Wheel** – Various sizes	$1.50			
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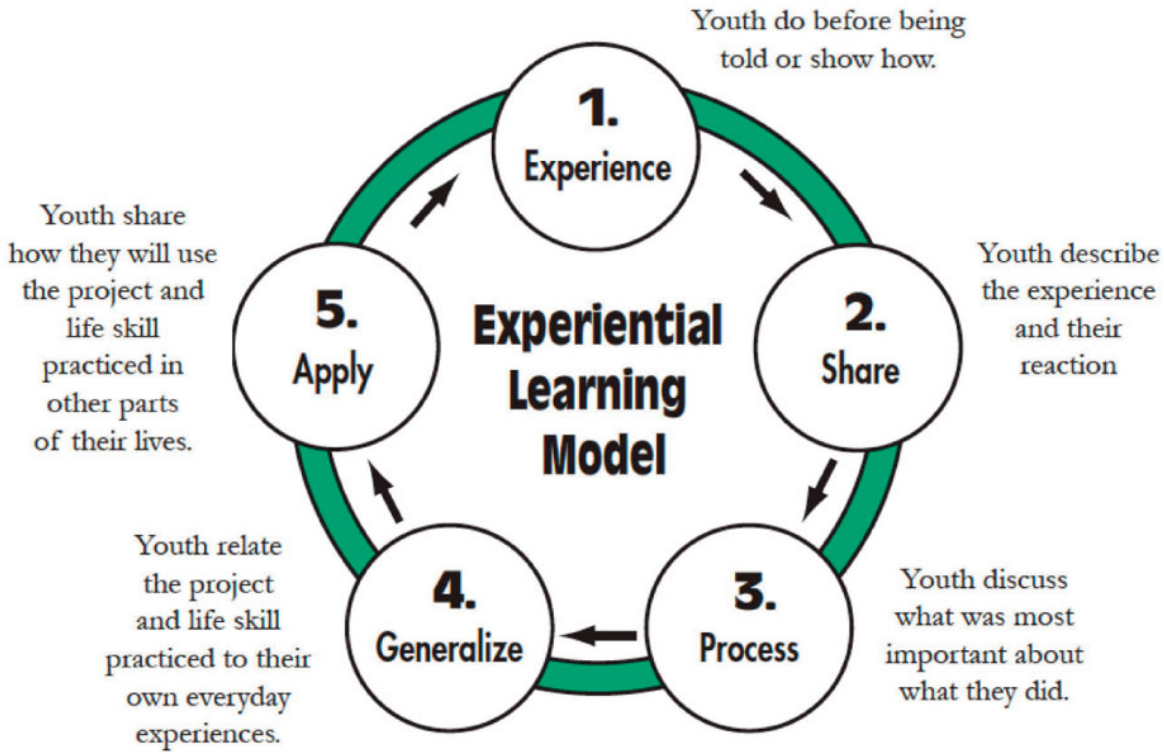
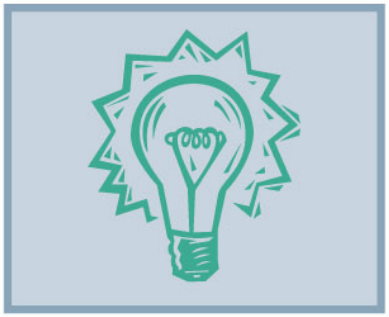
*only include complete items in good usable condition; not those cut, drilled, bent, taken apart, etc.		**Totals**			
			Total Parts Not Used	**Total Value of Parts on Hand (Inventory)**	

Experiential Learning Model



Pfeiffer, J. W., & Jones, J. E., *Reference Guide to Handbooks and Annuals* 1983, John Wiley & Sons, Inc. Reprinted with permission from John Wiley and Sons, Inc.

4-H Robotics Scenarios



Assessing Learning

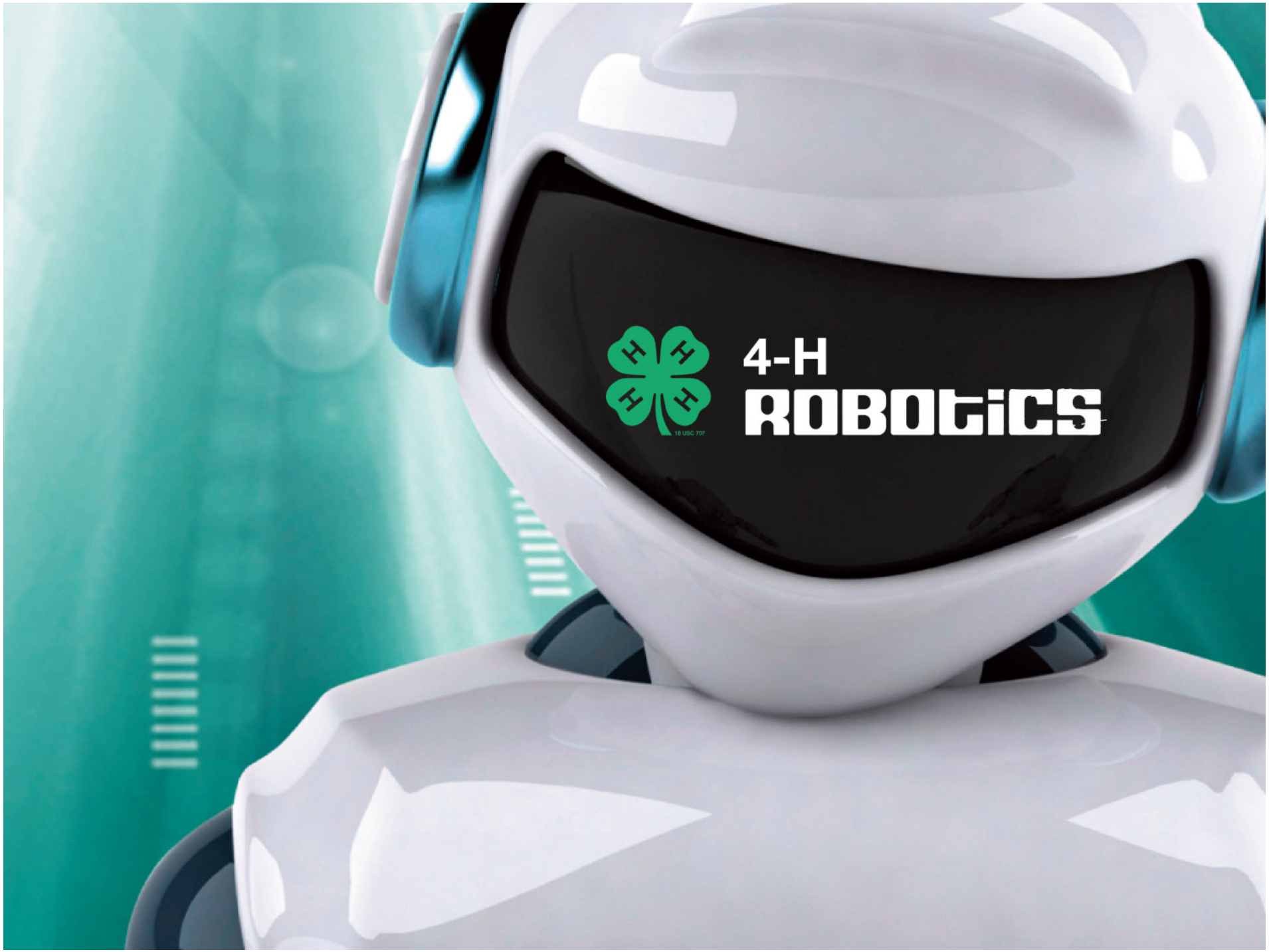
Teaching with Technology

Leading Discussions

Program Planning

Closing and Questions

- Developed personal knowledge to draw upon when leading *Junk Drawer Robotics*
- Applied the Engineering Design Process to solve a design challenge
- Developed strategies for implementing the Experiential Learning Model with youth


4-H
ROBOTICS