K-6 ROBOTICS ENGINEERING

JOHN HEFFERNAN

Tech Teacher, Williamburg Schools

TAP CREATIVE PLAY

- Are we tapping into the so important creative play of children in school, especially the kind associated with building?

TAP CREATIVE PLAY

It's more fun to actually be building something. If you took a class in robots and just learned about things, if the teacher just drilled information into your head, it would not be as fun as building and experiencing it to learn.

Grade 6 Girl 2

TAP CREATIVE PLAY

- Who is tapping into creative play? Are we?

Lego Robots directly tap into the creative play urge of children in a healthly and educational way

WHY ROBOTS?

- Engineering can be taught in many ways, why Lego Robots?
- Familiar, fun, fantasy
- They can be programmed, adds "life"
- Tech component built in
- Math, science, ELA as well

GOOD FOR BOYS

- We have found robotics especially good for boys with ADD and LD issues who do Legos at home and tech oriented boys that need challenges
- What other activities in elementary schools especially cater to boy's interests?

GOOD FOR BOYS

- It was very interesting that we got to build a real, live robot. I never imagined I would build a robot. It was really cool. *Grade 5 Boy 1*
- It's fun because it allows you to challenge yourself in a different way than just your mind, because you have to be able to figure out how things go together because that's physical memory. *Grade 6 Boy 1*

GOOD FOR GIRLS

- Girls don't always get to use Lego at home
- Need to be exposed to engineering before cultural constraints become strong

HOW IS IT DIFFERENT?

[It's] Absolutely! [different from other schoolwork.] It's more interactive because mostly what we are doing in school is paperwork. With this you get to experiment, instead of just doing something, like math, you got a question, you figure it out. With this you can, change it up, experiment. *Grade 6 Boy 1*

It's fun and different in a different way. I just think it is more fun. The way you think - easier is some ways, harder in some ways. The way you think is more fun to think that way than the other way. *Grade 4 Boy Team 2*

STEM PIPELINE

- STEM occupations are projected to grow by 17.0 percent from 2008 to 2018, compared to 9.8 percent growth for non-STEM occupations.
- STEM workers command higher wages, earning 26 percent more than their non-STEM counterparts.
- We need creators of technology, not just consumers.
- Will we be STEM competitive in the new global economy?

Grade 6 Robots – Pre-Survey

NAME [redacted] DATE 3-30-11

What is a robot? a robot is a Mechanical divice that you can Program to do different thing.

What is engineering? Engineering is a type of work that involves Mechanics

How much do you agree or disagree with these statements? Circle One.

I want to be an engineer or scientists when I am older.

Strongly Agree Agree (Neither Agree or Disagree) Disagree Strongly Disagree

I like using computers and other technology.

(Strongly Agree) Agree Neither Agree or Disagree Disagree Strongly Disagree

NATIONAL AND STATE STANDARDS

I didn't think you would use all that math and science to build that robot. *Grade 6 Girl 2*

It's more fun [than usual schoolwork.] It's a lot different – sometimes mathematical. You have to think in a different way. This would make this, would make this, happen. Each step is connected. *Grade 4 Boy Team 2*

Teachers have integrated math, science, technology, programming, art, music, ELA

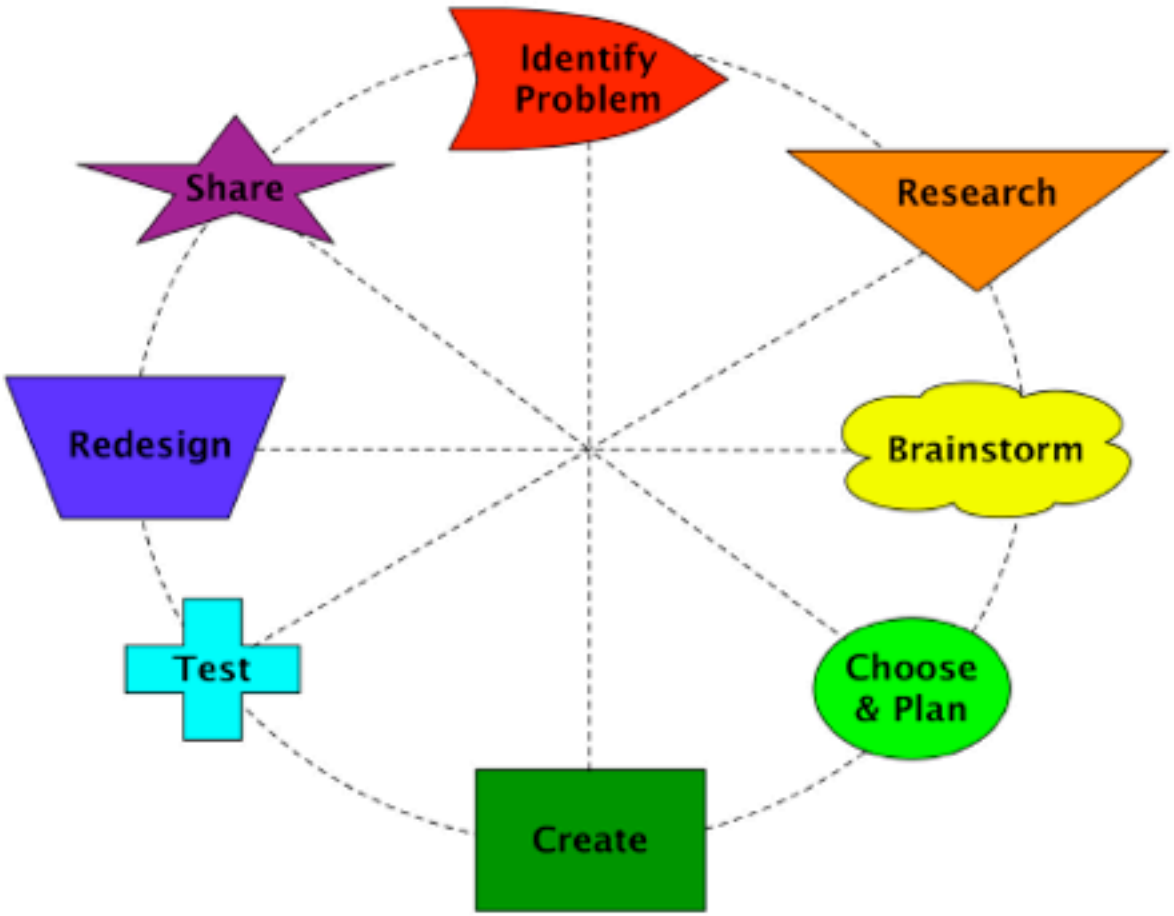
Other important 21st Century Skills, collaboration, communication, problem solving

National and state standards and tests will have much more engineering in them in the future as well as utilizing embedded Math and ELA Common Core standards

ENGINEERING

- Not all kids should or need to be engineers but:
  - We have created a lot of problems with our technology and will need ethical engineers and scientists to solve them
  - Practices a way of thinking based on reflection, fact based research, iterative and revision, collaboration, and sharing out

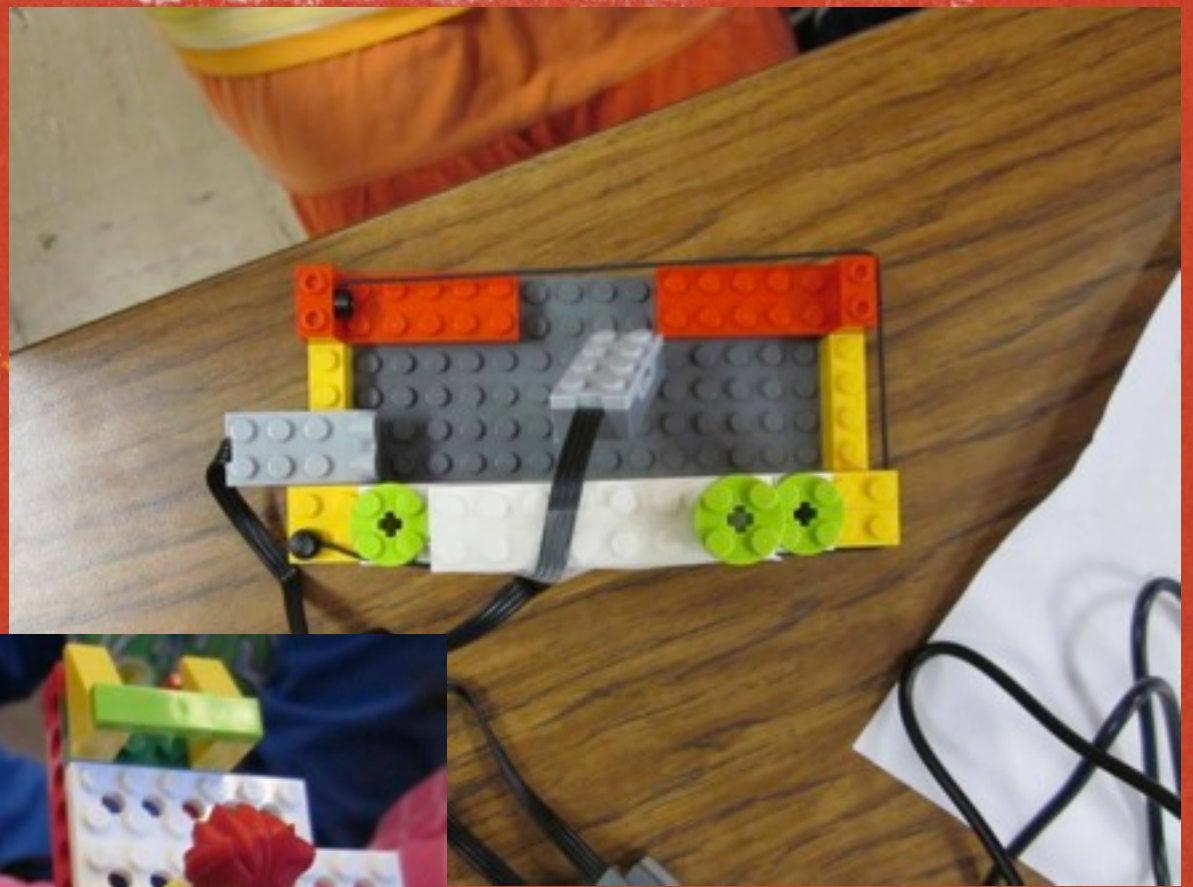
Engineering Design Process



GRAPPLING

GRAPPLING 2

ENGINEERING DESIGN



YEAR 1 CLEVER SOLUTION

DEPTH OF LEARNING

15.5

GRADE 5/6 LEGO LESSONS #2 – MOTORS – NO SENSORS

TEAM DATE 4/6/11

Follow the checklist below.

- √ The car turns clockwise for 5 seconds. 8.375
- √ The car turns counterclockwise for 5 seconds. 125
- √ The car goes in a straight line for 3 seconds.
- √ The car goes forward for 2 seconds, makes a 90-degree turn, goes forward for 2 seconds and stops.
- √ The car follows a taped square on the floor.
- √ The car follows a taped path on the floor.

GRADE 6 VELOCITY WORKSHEET

NAME Corie DATE ____________

- √ Measure 10 feet and mark the distance in some way.
- √ Create a program that goes indefinitely. Set the motor power to 75%.
- √ Using the wall clock's second hand or a stopwatch, record how long it takes to go 10 feet. 11 seconds

Calculate the velocity (rate) of your robot in feet per second. Distance = rate x time.

Rate = 1.1 feet/second

Compare your results with others.

Why are results different for different teams? lighter robots

What was the fastest speed? 1.016 sec

Extra credit

What is the velocity of a robot car with the power set to 100%? 8sec per 10 foot or .8 in 1 foot

What is the slowest speed you can get the robot to go? ____________

COOPERATIVE LEARNING

- Number of students in a team
- Roles
- When problems arise
- Managing space
- Managing technical difficulties

FUN

It was hard so it made us jump up and down when it finally worked. *Grade 5 Girls Team 1*

BEEBOTS

- Made by Terrapin Logo
- 5 BeeBot Bundle for $400 with mat, cards, and shells
- Requires AA batteries
- Left, Right, Forward, Back, Pause, Clear, Go, On/Off

BEEBOT MEASUREMENT

- BeeBot forward step - how long is it?
- Estimation - how many BeeBot steps to ...
- Measurement

NAME CARTER

BEES AND HONEY #1

HIVE	STEPS
1 ✓	6
2 ✓	7
3 ✓	6
4 ✓	3
5 ✓	4
6 ✓	6

K - TEACH YOUR BEEBOT

- Recognise letters (read) - use block letters only, why?
- Recognize numbers (math)
- Count
- Add
- Subtract
- Use number lines and masking tape

K - BEES AND HONEY

- Open ended challenge - why?
- Culmination of long BeeBot unit
- Winter/Spring
- Props
- Can tie in with science
- Preplanning routes (design - choose and plan)

BEFORE MAP SAMPLE

NAME Ali I

B

Draw the path the BeeBot took to the flower.

EXAMPLE OF ROUTE PLANNING WITH RULERS

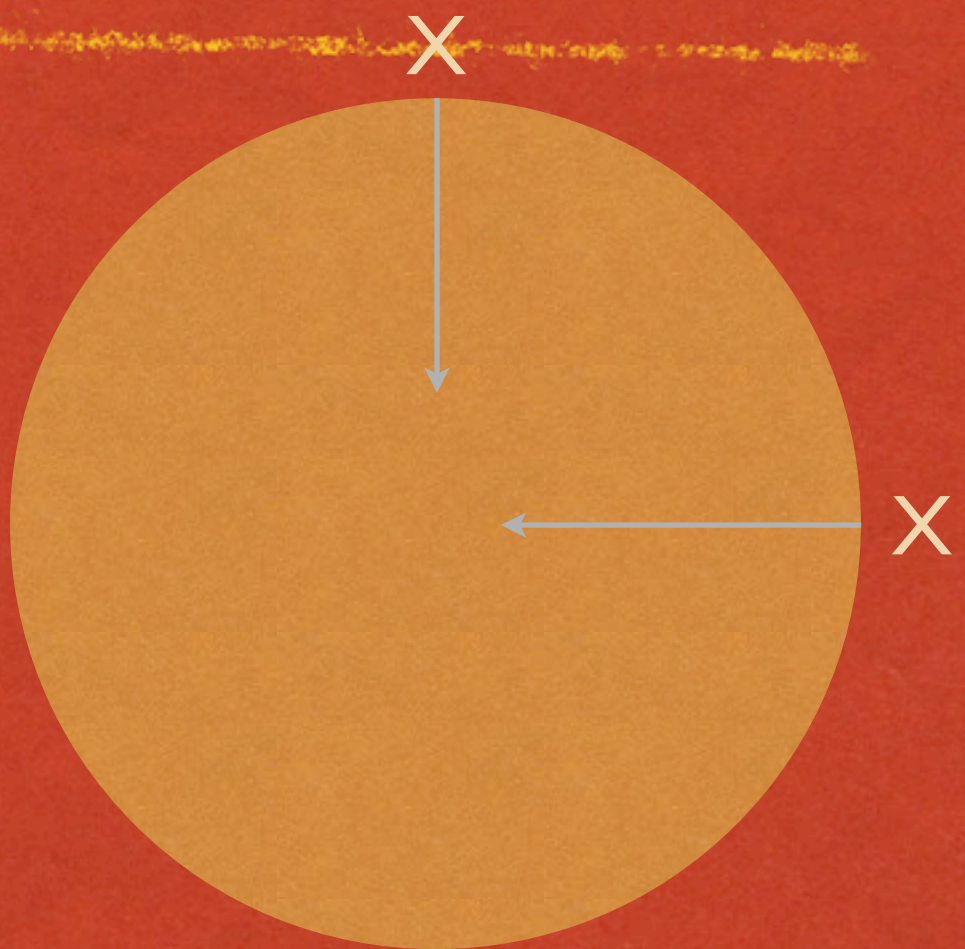
YEAR 1 CLEVER SOLUTION

K ENGINEERING CONCLUSIONS

- Balance of "open endedness" and "doability" difficult to achieve
- Difference in time of year
- Difference in classes
- Evaluate and modify how much scaffolding is needed

TRAFFIC JAM

- Teaches the Pause button
- Teaches cooperation
- Use tape (cross)



LEGO WEDO ROBOTICS

- Getting Started - grade 1
- Dancing Birds - grade 1 (Physical Sciences)
- Smart Spinner - grade 2 (Physical Sciences)
- Drumming Monkey - grade 2 (Physical Sciences)
- Amusement Park Ride - grade 2
- Amazing Adventures - grade 3 (3 robots, ELA)
- Soccer - grade 4 (Math)
- Burglar Alarm - grade 4

TIPS

- Don’t solve problems for them
- Use the Activity Guide (note Macintosh issue)
- Extra kits, resource kits
- Kids can inventory
- Build up slowly - no sensors or loops
- Try other USB port, try motor by itself, switch components (brain, computer), use simple program

MORE TIPS

- Use of other materials such as paper, cardboard, crafts materials
- Provide a context such as Olympics, Field Day, or Zoo
- Levels of programming/scaffolding
- Computer are dumb, they do what you tell them to do, not what you want them to do
- Pacing - be prepared, options
- Pick one part or one part at a time (building, programing, experiment)

LEGO MINDSTORMS

- Grade 5 - Build basic car
- Grade 5 - Follow lines - no sensor
- Grade 6 - Build basic car
- Grade 6 - Calculate velocity
- Grade 6 - Use sensor to stop/avoid obstacle
- Grade 6 - Challenge - build faster car using gears

TIPS

- Repeatability especially with courses taped on the floor
- Picking up the robot – good for seeing what is going on with the wheels, bad if kids try to adjust/fix the programmed course
- Sound sensor can hear itself. Turn up to 100. Do in a quiet place.
- Don’t solve problems for them

TIPS 2

- For basic car, measure/figure our relationship between circumference of wheels, rotations, distance traveled, etc.
- Figuring out 90 degree turn.
- Extra kits, resource kits
- Inventory
- Use USB and not Bluetooth

TIPS 3

- Check for correct (or any) wiring
- Use computer to see if wheels turn/sensors work
- Check that robot is running the right program
- Do not need to download program each time
- Build up slowly - no sensors, sensors, loops
- Computer are dumb, they do what you tell them to do, not what you want them to do

Resources

- jheffernan@hr-k12.org
- http://www.kidsengineer.com/ (PK-6 Curriculum Maps)

SUPPLIES

- BeeBots
- Batteries
- Number line
- WeDo Teacher's Guide
- Adapter
- USB drive
- NXT Robot
- WeDo Robot
- Laptop