

TEACHING ENGINEERING WITH BEEBOTS

JOHN HEFFERNAN
Tech Teacher, Williamburg Schools



Monday, August 12, 13

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?





12/12/13

Bella

1	0	2	7	3	4	9					
A	B	C	D	E	F	G	H	I	J	K	L
M	N	O	P	Q	R	S	T	U	V	W	X
Y	Z										

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



WHY 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 in 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 _____ DATE 3-30-11

What is a robot? *a robot is a mechanical device that you can program to do different things.*

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

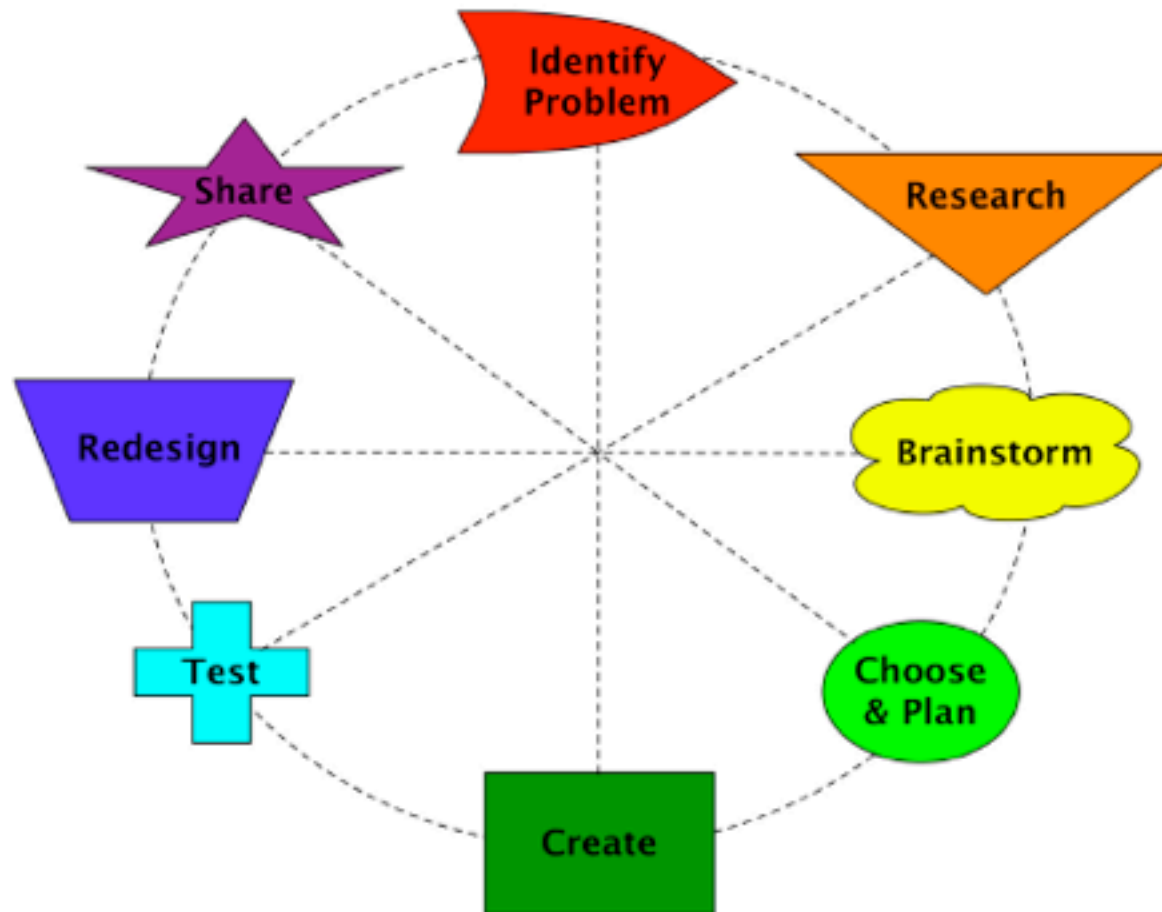
ENGINEERING

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



Courtesy - Dr Merridith Portsmouth, Tufts CEO

GRAPPLING



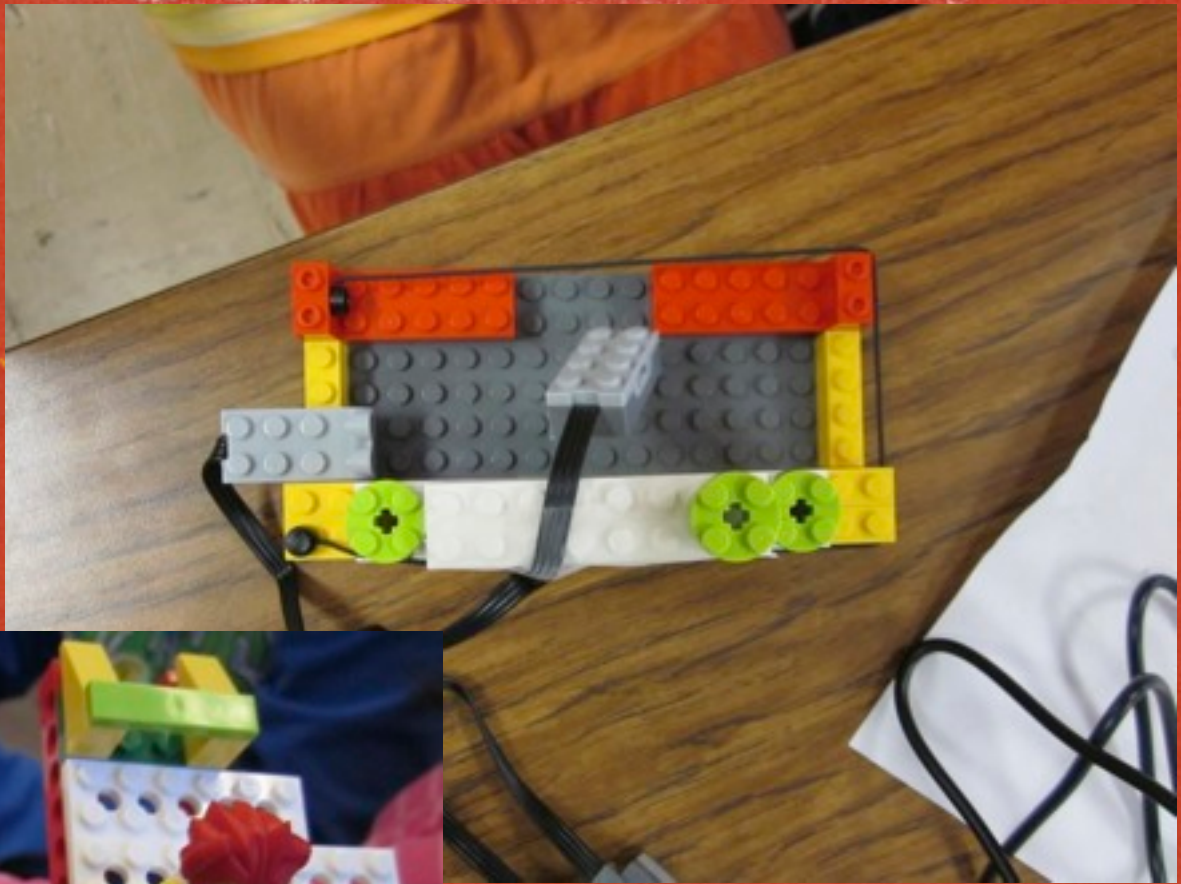
GRAPPLING 2



Monday, August 12, 13

ENGINEERING DESIGN

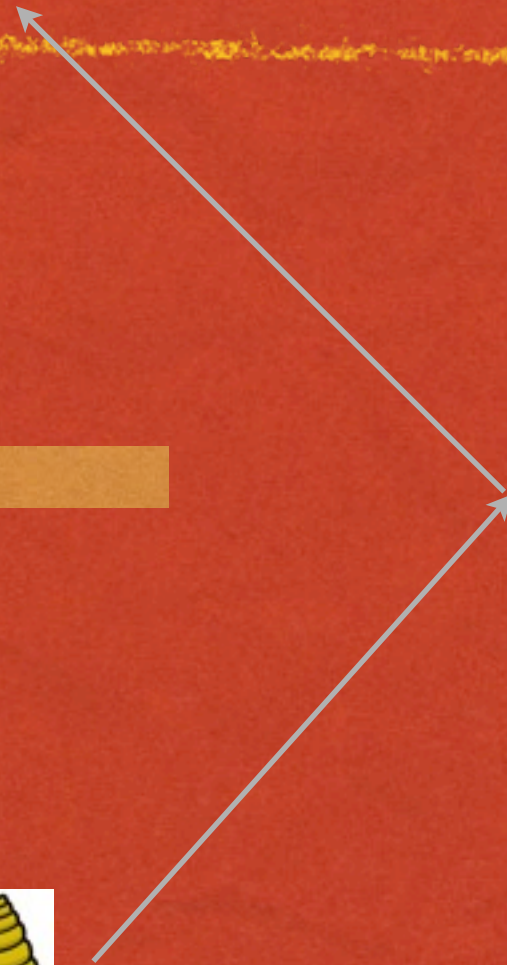




YEAR 1 CLEVER SOLUTION



Open Ended Challenges



DEPTH OF LEARNING

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. 15.5
- The car turns counterclockwise for 5 seconds. 8.375
- The car goes in a straight line for 3 seconds. 125
- 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. 16.74 $\frac{2}{3}$

$$\begin{array}{r}
 2 \overline{) 16.756} \\
 \underline{-16} \\
 107 \\
 \underline{-107} \\
 156 \\
 \underline{-156} \\
 0
 \end{array}$$

$$\begin{array}{r}
 1256 \\
 \times 41 \\
 \hline
 1256 \\
 5024 \\
 \hline
 51264
 \end{array}$$

$$\begin{array}{r}
 1256 \\
 \times 1267 \\
 \hline
 8792 \\
 25120 \\
 125600 \\
 \hline
 1507267
 \end{array}$$

$$\begin{array}{r}
 150.726 \\
 \underline{-36} \\
 114.726 \\
 \underline{-72} \\
 42.726 \\
 \underline{-36} \\
 6.726
 \end{array}$$

GRADE 6 VELOCITY WORKSHEET

NAME Coie 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 feet or

What is the slowest speed you can get the robot to go? _____ .8 in 1 sec

$$\begin{array}{r}
 11 \overline{) 1100} \\
 \underline{-99} \\
 110 \\
 \underline{-110} \\
 0
 \end{array}$$

$$\begin{array}{r}
 10 \overline{) 11} \\
 \underline{-10} \\
 10 \\
 \underline{-10} \\
 0
 \end{array}$$

$$\begin{array}{r}
 10 \overline{) 80} \\
 \underline{-80} \\
 0
 \end{array}$$

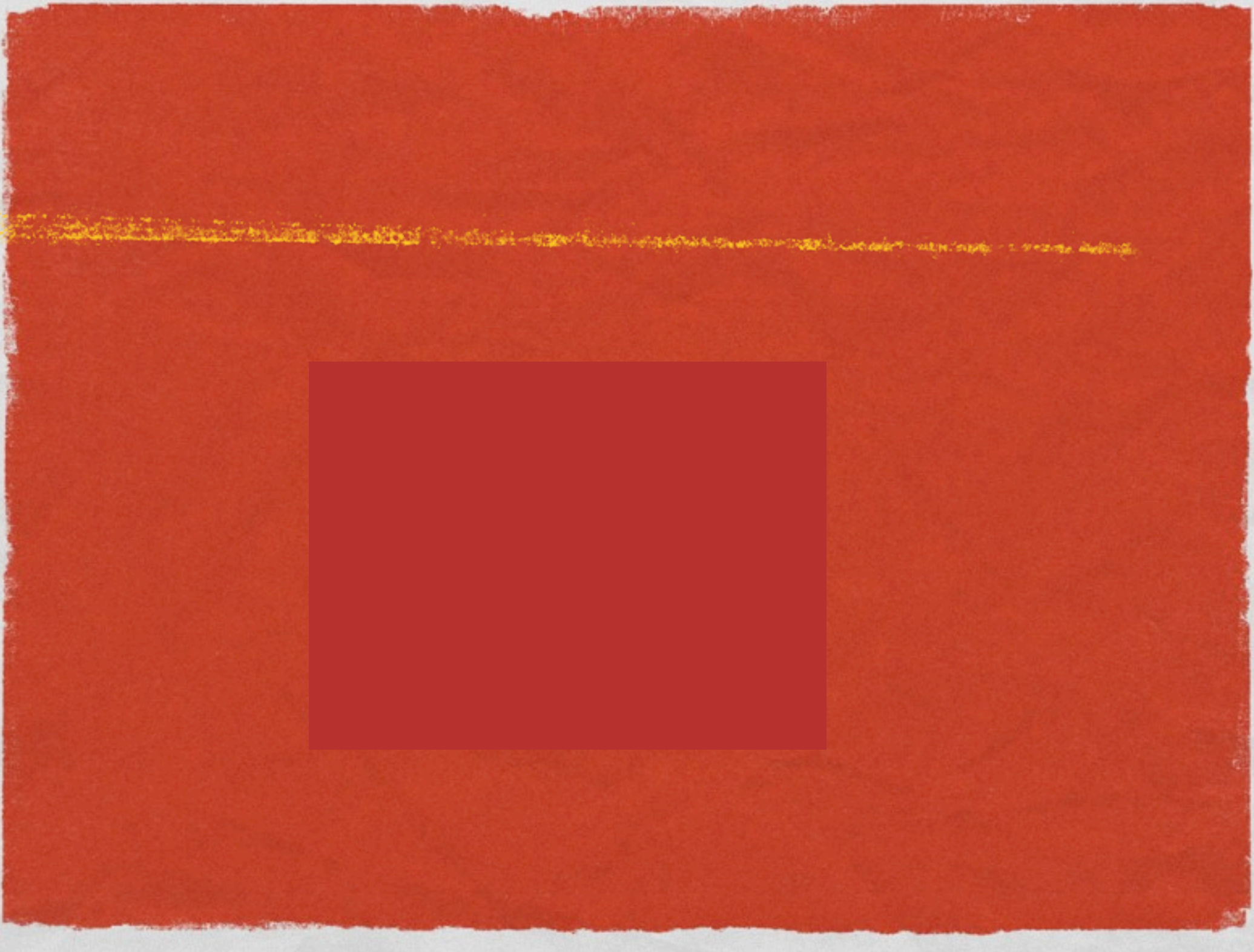




FUN



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



Monday, August 12, 13

BEEBOTS - PK-K

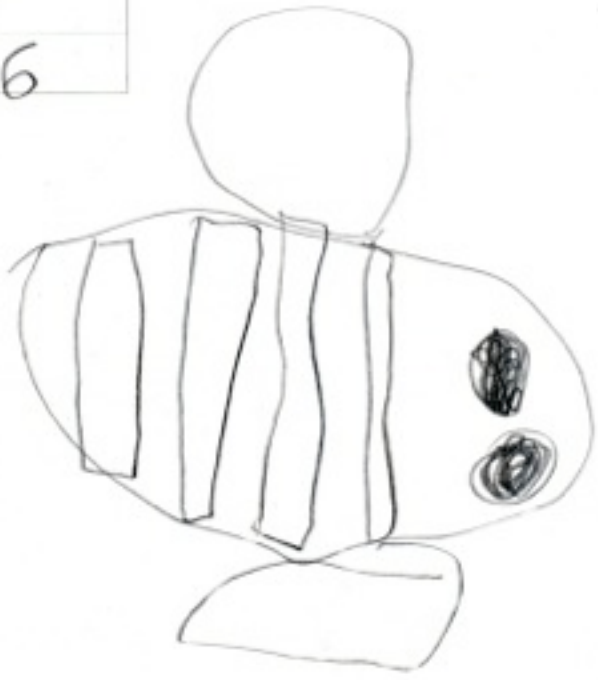
Simple Bee Robot (left, right, up, down, clear, pause, go)

PK- Free explore, counting on a number line, trace letters

K - Trace letters, adding and subtracting on a number line, estimation and measurement, route planning challenge, traffic jam

NAME CARTER BEEES AND HONEY #1


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



BEFORE MAP SAMPLE

NAME ATTI B

Draw the path the BeeBot took to the flower.



The diagram shows a BeeBot at the top, a rectangular obstacle in the middle, and a flower at the bottom. A hand-drawn line indicates the path the BeeBot took: it starts at the BeeBot, moves down, then curves around the left side of the obstacle, then down again, and finally reaches the flower.

EXAMPLE OF ROUTE PLANNING WITH RULERS



LESSONS LEARNED

- Don't solve problems for them
- Build up slowly
- Computer are dumb, they do what you tell them to do, not what you want them to do

COOPERATIVE LEARNING

Number of students in a team

Roles

When problems arise

Managing space

Managing technical difficulties

BEEBOTS TASKS

- Estimation and measurement
- Make some letters
- Add 2 numbers
- Subtract 2 numbers
- Traffic jam
- Bees and Honey
- Dice games - make 10, race

EXTENSIONS

- Design your own activity to use with BeeBots
- Closed or open ended
- Try it
- Document it including adjustments

RESOURCES

- jheffernan@hr-k12.org
- <http://www.kidsengineer.com/> (PK-6 Curriculum Maps)
- Lesson plans
- Worksheets

SUPPLIES

- BeeBots - in crate
- Batteries - check crate
- Number lines - check crate
- BeeBot rulers - check crate
- Masking tape - check crate
- Video adapter
- Power cord
- Laptop
- K Worksheets
- PK and K Lesson Plans
- Handouts
- Post handouts
- Book (home) - for standards