K-6 ROBOTICS ENGINEERING

JOHN HEFFERNAN
Tech Teacher, Williamburg Schools

What's going on here? Have you seen your kids doing something like this? What does this have to do with learning?

Isn’t that where the urge to engineer comes from?

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?

What we see at recess? Are they not getting it at school?

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

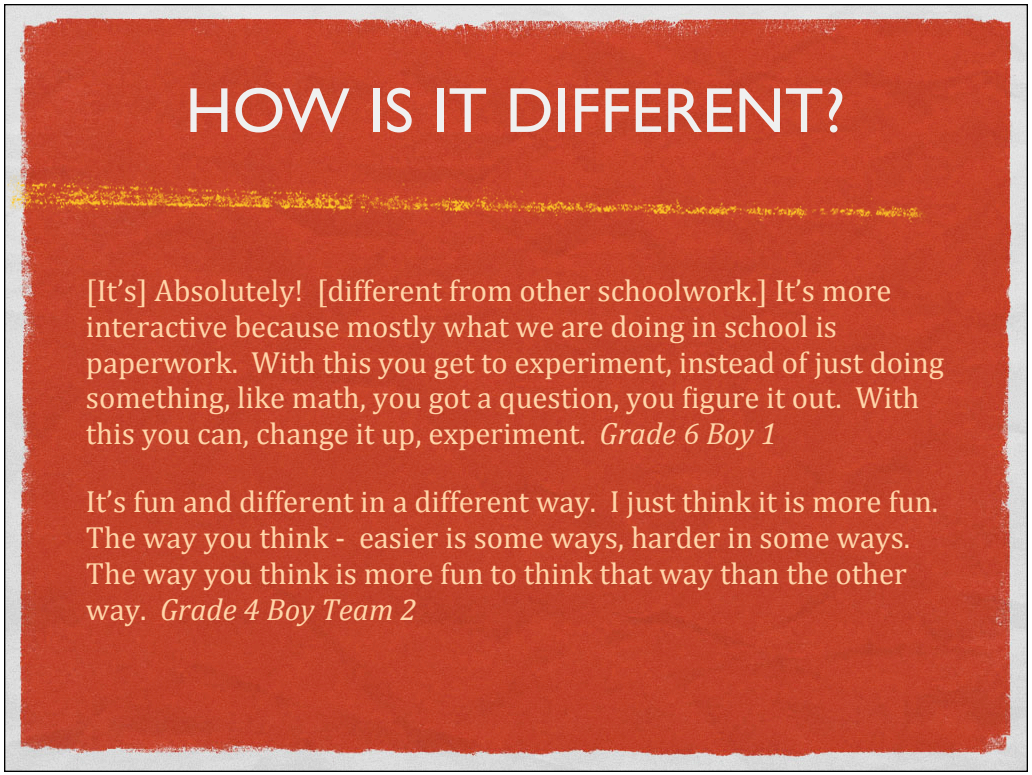
Examples: – writing, no hands-on, language oriented, sitting still, roughhousing, toys, video games. Are we providing healthly outlets for boy's culture? Examples: + video game creation, robotics, hands-on science, take apart centers

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

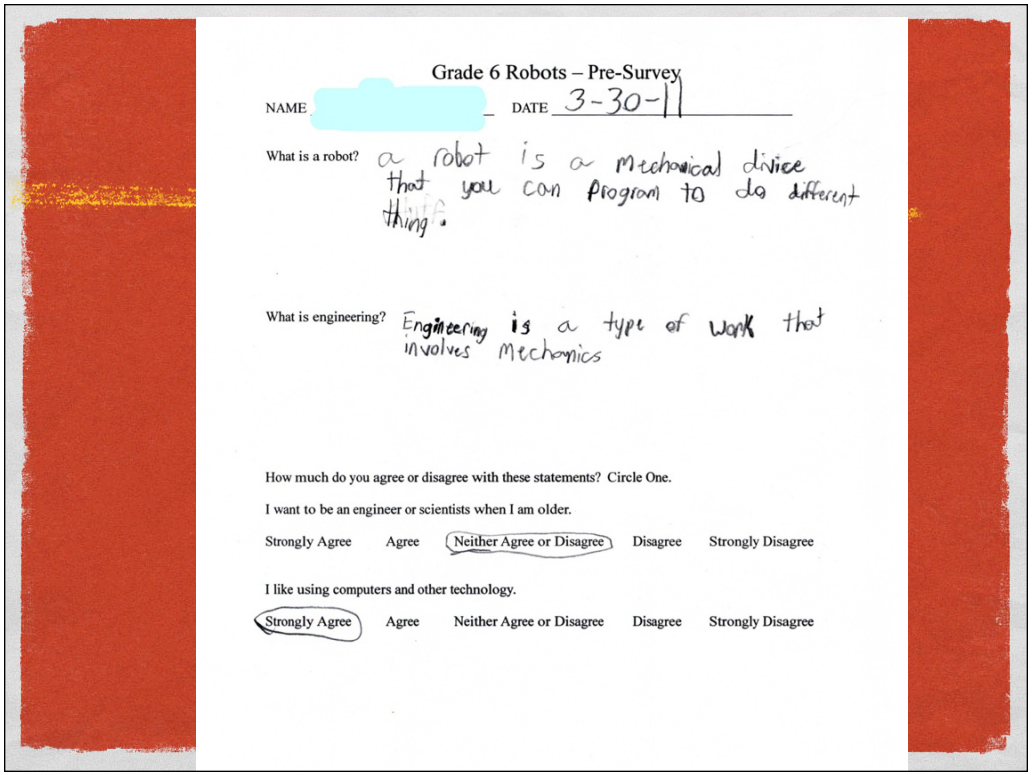
- Girls don't always get to use Lego at home
- Need to be exposed to engineering before cultural constraints become strong



Do you think this is fun and engaging for kids?

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's.

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

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

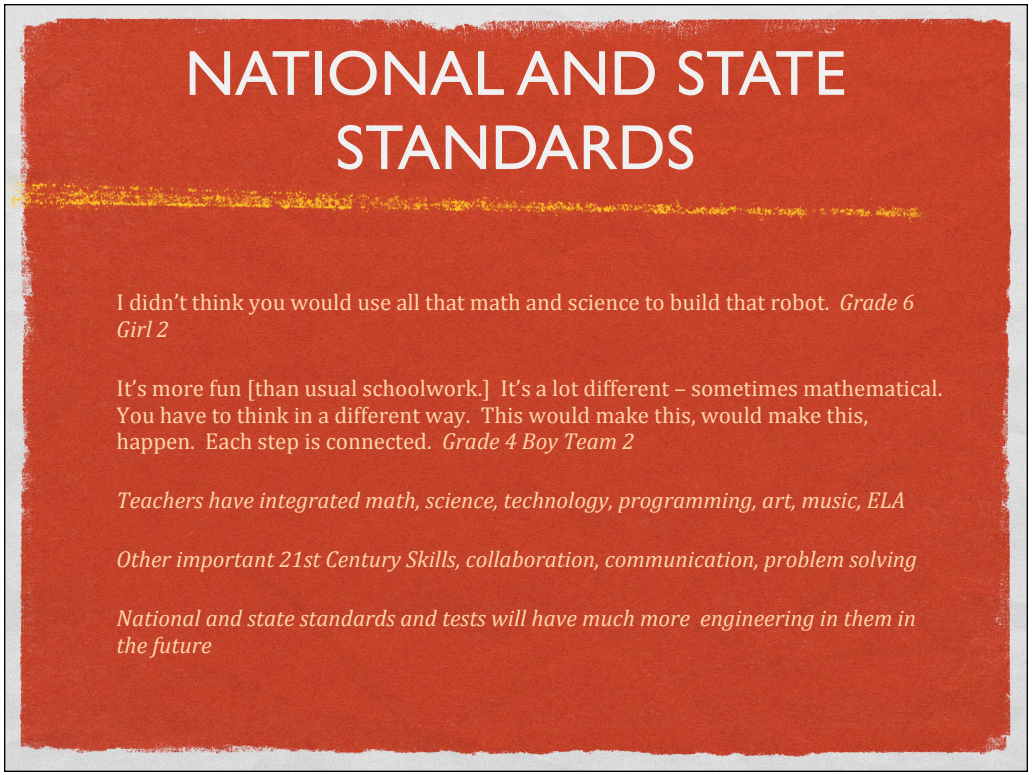
I want to be an engineer or scientists when I am older.

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

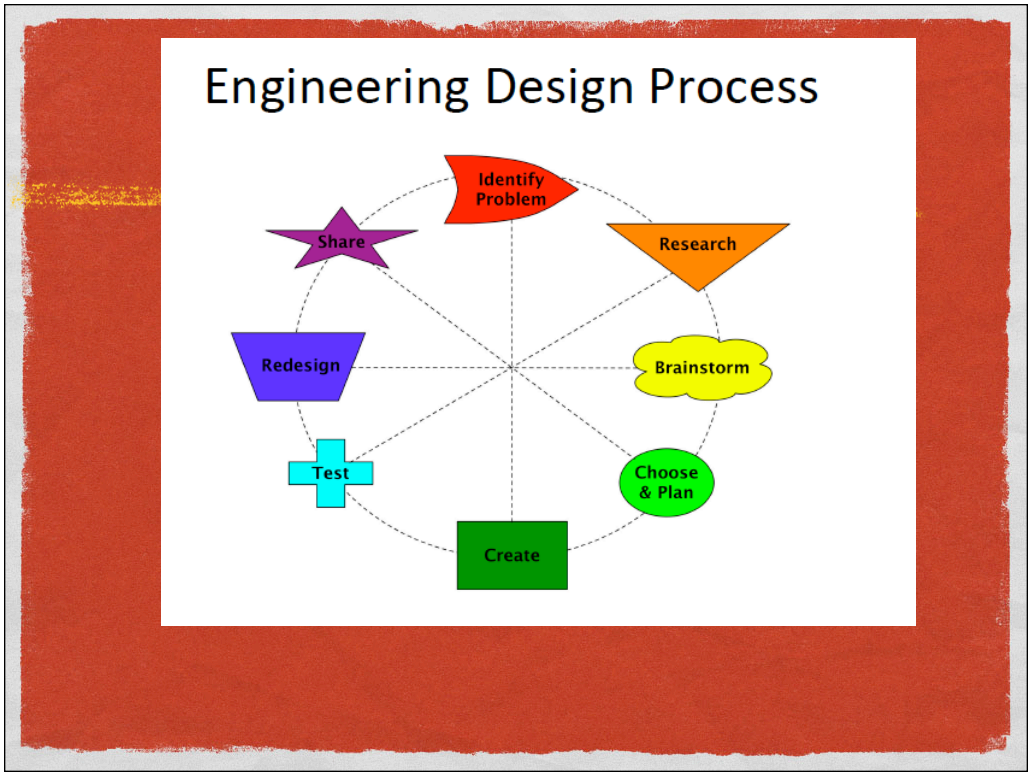
Want to move the first question to the left so kids are not just consumers.



Integration examples: solve a problem from a story (chair engineering, better mousetrap (Ralph), design an instrument, decorate robots

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

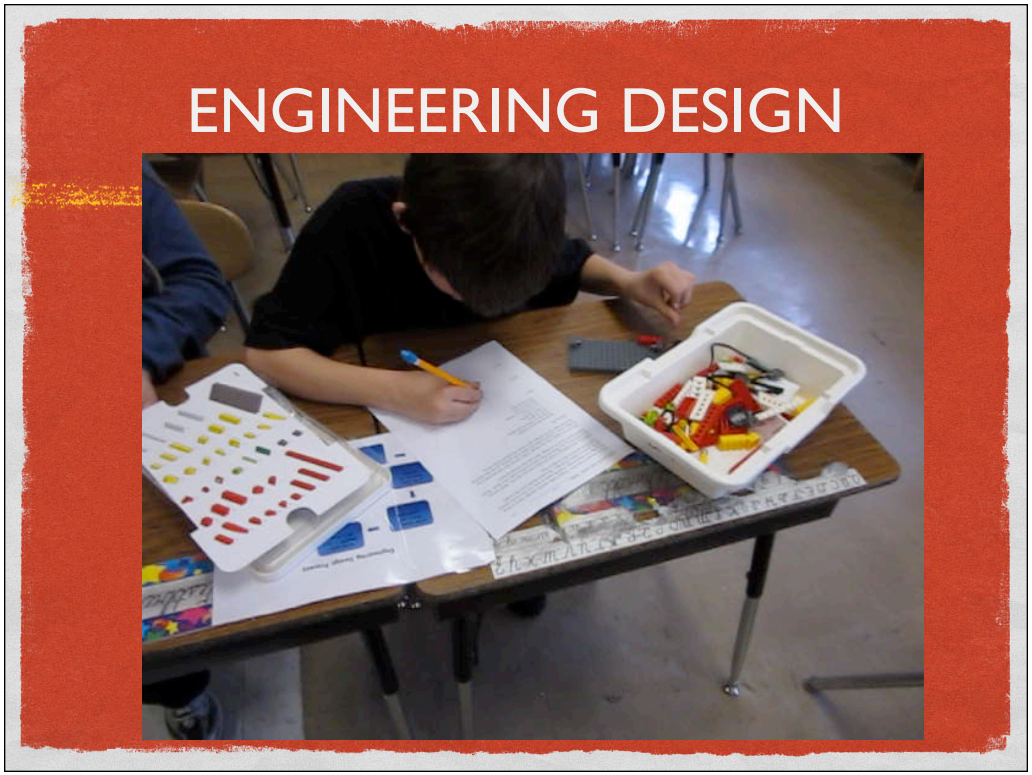


Go over and explain: step 1 sometimes overlooked but critical. The same, in essence as other processes.

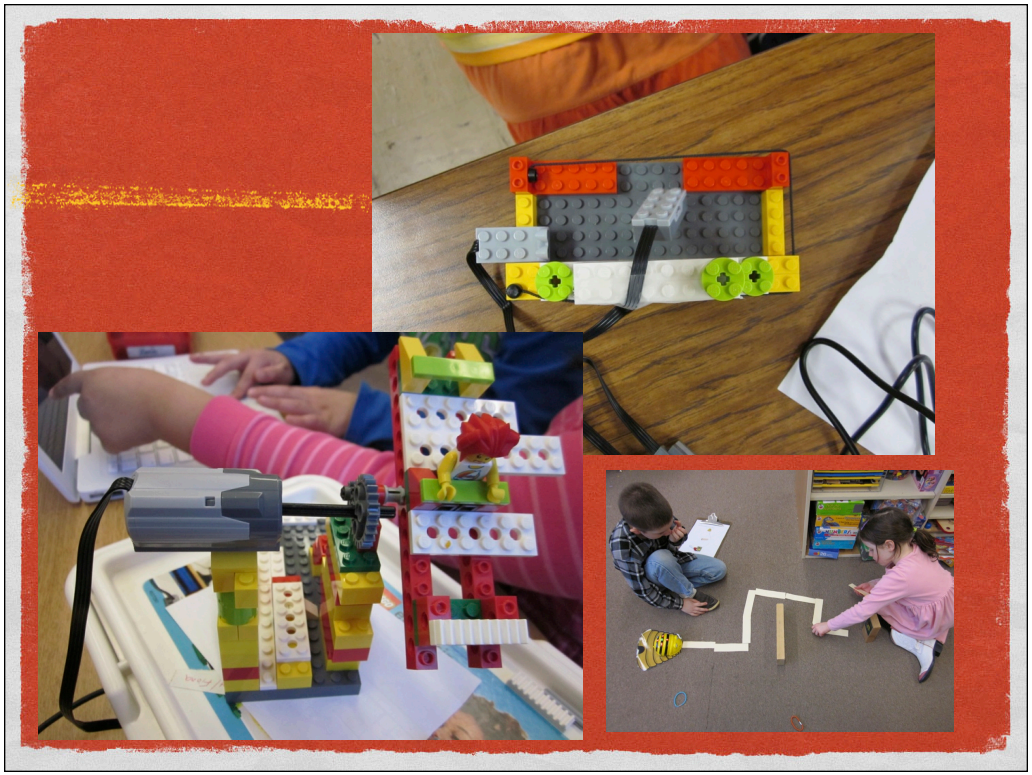
GRAPPLING

GRAPPLING 2

Open ended challenges are a change for the teacher.

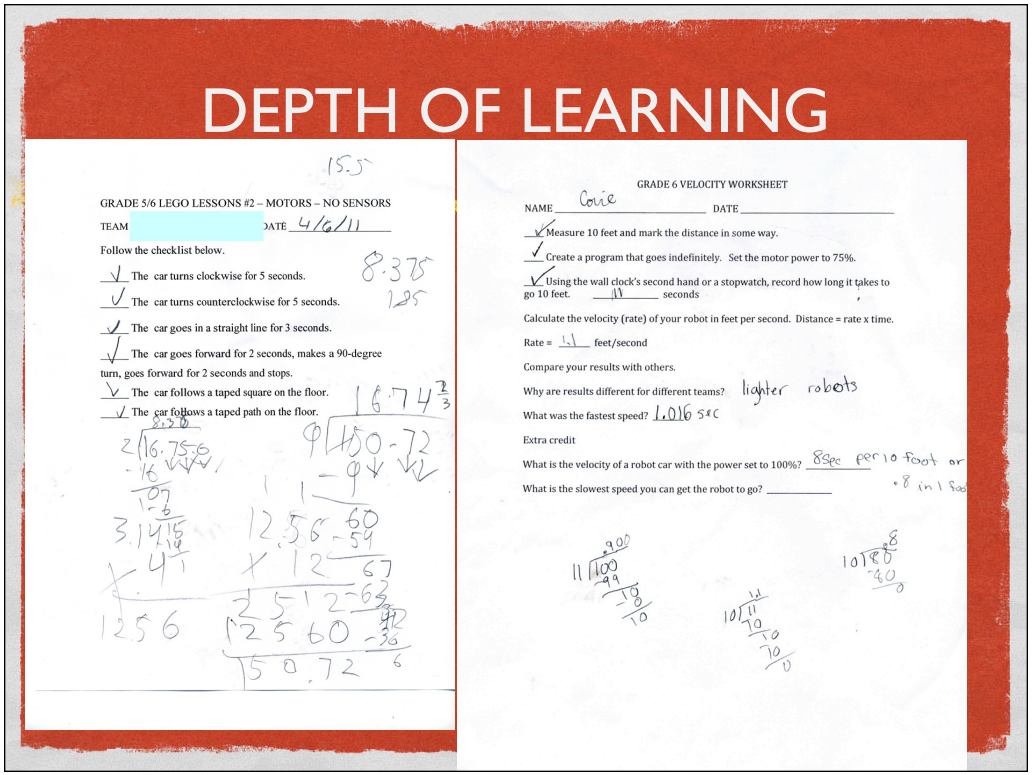


Grade 4 Burglar Alarm Example



Some open ended challenge design from grades K, 2, and 4. Name challenges. Challenges are important to really experience engineering and also to see where the students can take things. Critical for (underserved) students who need more challenges.

DEPTH OF LEARNING



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

TEAM [redacted] DATE 4/6/11

Follow the checklist below.

- √ The car turns clockwise for 5 seconds.
- √ The car turns counterclockwise for 5 seconds.
- √ 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 sec

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

How much more meaningful is this than a workbook sheet on velocity, long division? Learning is in context of solving of problem. Saw many examples where deeper understanding was missing until they had to actual use their math. Think of one!???

FUN

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

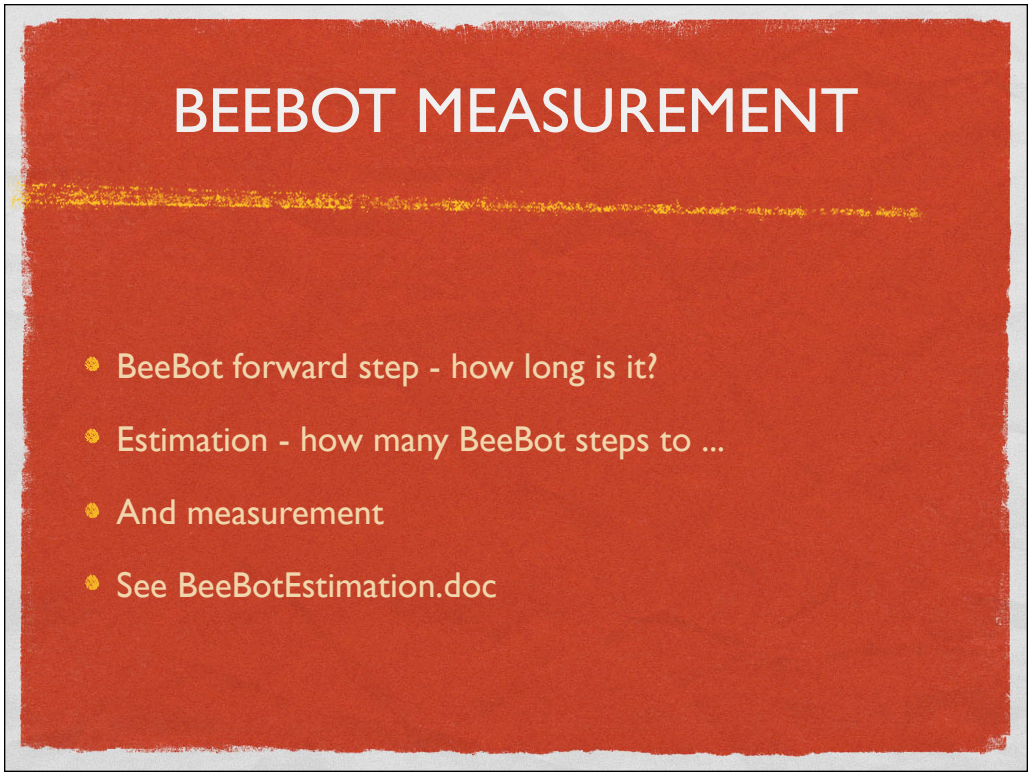
Example of Scarlet running back and forth from computer to test area

COOPERATIVE LEARNING

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

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
- Try it!



Should be 15 centimeters or 6 inches

No estimation in this K example

K - TEACH YOUR BEEBOT

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

BEEBOT TIPS

- Picking up BeeBots
- Clear
- Change batteries if you see problems
- Be clear on where to start BeeBot
- Whole class modelings (have kids do it)\
- Model moving BeeBot
- Worksheets
- Programming whole trip before starting

MANAGING BEEBOTS

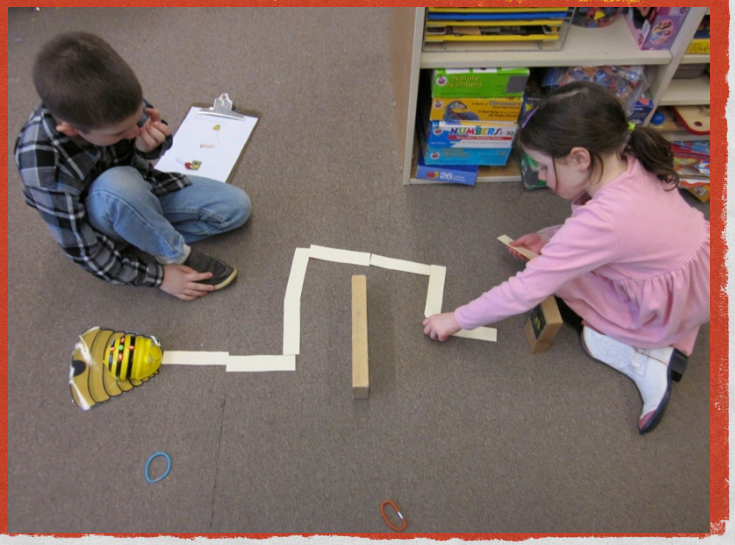
- Partner consideration and Cooperative learning skills
- Checklists
- K considerations
- Clear button
- On/off
- Batteries

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

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

MATS

- Can be used as a way to pick the answer
- See BeeBot Lessons
- Try one

GRIDS

- Problem Solving With BeeBots by Lester Carr
- Challenges
- Find It Challenges
- Graph It Challenges
- Map It Challenges
- Predict It Challenges
- Scramble It Challenges

TRAFFIC JAM

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

GEOMETRY

- Trace shapes (square/rectangle)
- Make shapes
- Perimeters
- 90 degree angles
- Create a rectangle for others to try
- Add estimation

BEEBOT RACE

- Students race their BeeBot across the floor.
- Make a start and finish line
- Program
- 1-2-3 Go
- Why are some faster than others?
- Dice variant (1,3,5 back, 2,4,6 forward)

CUMULATIVE PROGRAMMING

- Students can program cumulatively or not
- Be consistent
- For non-cumulative, can use aids such as rulers and turn markers and notes
- Acting out method

BEEBOT ADVENTURES

- http://mybeebot.wordpress.com/welcome-beebot-parents/1st-adventure/

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

DANCING BIRDS

- No sensors
- Good intro project
- Students can experiments with sounds
- Note sound resource sheet
- Note experiment resource sheet
- Science component
- Separate into building, programing, experiment

DANCING BIRDS 2

- Demo
- Build Dancing Birds
- Follow Activity Guide and/or Student Book
- Do experiment
- Modify sounds
- Can you think of ways to modify the design?
- What math and science is taught? Other subjects?
- How was it to work in a group?

TIPS

- Don't solve problems for them
- Some may need help with building directions
- Use the Activity Guide (note Macintosh issue)
- Extra kits
- Inventory
- Use computer to see if wheels turn/sensors work
- Build up slowly - no sensors, sensors, loops
- Try other USB port, try motor by itself, switch components (brain, computer), use simple program

MORE TIPS

- Watch out for confusing icons - Wait For and Motor On For
- More motors and shafts
- 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

EVEN MORE TIPS

- Watch for hidden second row in WeDo SW
- Pacing - be prepared, options
- Pick one part or one part at a time (building, programing, experiment)

SMART SPINNER

- Build Smart Spinner
- Do experiment
- Can you modify to make is spin longer?
- Who can make their spinner go the longest?

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

HANDS ON

- Build or bring in basic car - follow book
- Program to go in a straight line for 5 seconds
- Program a 90 degree turn
- Make a square on the floor
- Follow a taped path
- Add sound sensor - avoid dummy when the robot hears a sound

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
- Down thing in Mindstorms – what is it?
- 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.
- Measure the speed of a robot (in MPH)
- Extra 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/
- http://mybeebot.wordpress.com/

SUPPLIES

- BeeBots
- Batteries
- Mats
- Number lines
- Markers
- Masking Tape
- 2 Curriculum Books
- Projector/speakers
- Snacks/coffee?
- Grid paper
- Rulers
- Meter sticks
- Scissors
- Worksheets
- Files (online?)
- Sign in/evalulations
- Cards
- Challenges Sheets (1 of each)