Introduction to Elementary Robotics

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Introduction

- Elementary and Middle School Engineering Education with a focus on robotics
- Some background
- Activities
- Wrap-Up

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



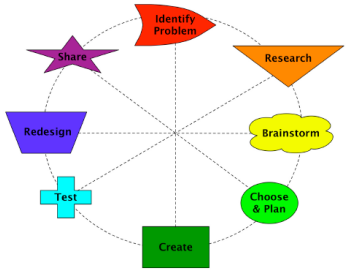
- Who is tapping into creative play? Are we?


Lego Robots directly tap into the creative play urge of children in a healthy and educational way. A PK-6 robotics curriculum (such as Elementary Engineering Curriculum) is needed to support and sustain the natural engineering instincts of young children until formal engineering

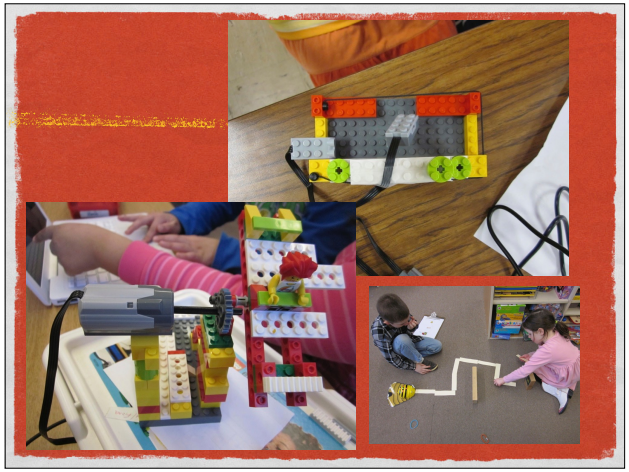
WHY ROBOTS?

- 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

Engineering Design Process



Courtesy - Dr Merridith Portsmore, Tufts CEEO

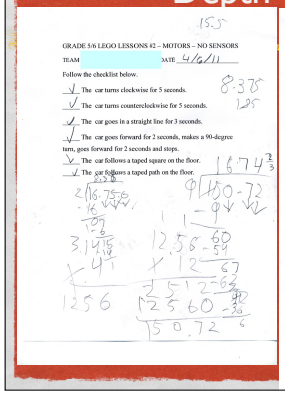


Grappling

Year 1 Clever Solution

Open Ended Challenges

Depth of Learning

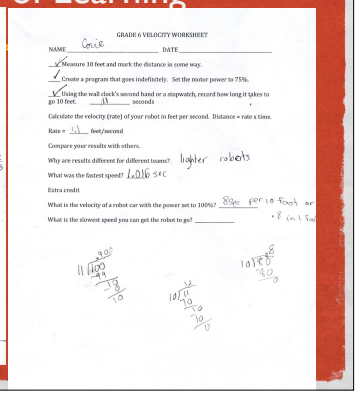


GRADE 5/6 LEGO LESSONS #2 – MOTORS – NO SENSORS

TEAM _____ DATE 4/6/11

Follow the checklist below.

- √ The car turns clockwise for 5 seconds.
- √ 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 Grace 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%? 85sec per 10 feet or 8 in 1 sec

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

Motivating

Fun

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

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*

More Quotes

- 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

What did you like about robotics?

- What did you like about robotics?
- 24 Mentioned the project as fun
- 15 Got to build/hands on
- 8 Different than other school work/special/exciting
- 7 Liked the programming even though it was hard
- 5 Cool
- 4 It was satisfying/exciting getting things to work
- 2 Liked the trial and error
- 2 Had to learn to compromise, work together
- 2 Got to move around, not stay in seat

RESEARCH - Interview results

- Student very aware of how they are being taught
- Prefer hands on activities and believe they learn better that way

Grade 6 Robots – Pre-Survey

NAME [redacted] 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

Teacher Interview

Student Interview

Dancing bird activity

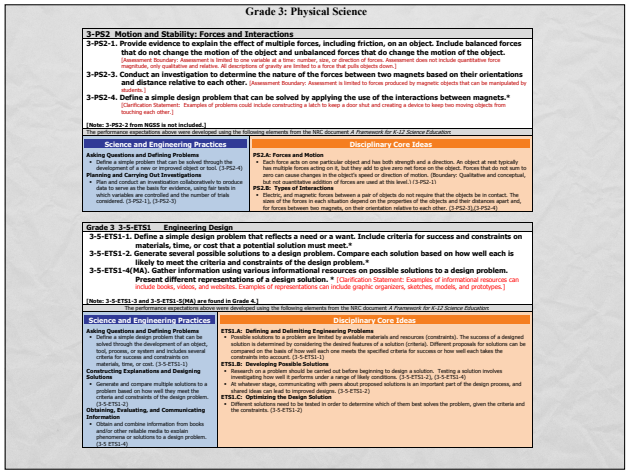
- Build Dancing Bird with partner according to the directions
- Create a simple program to make the birds move for 10 seconds
- Do the LEGO created experiment with the pulleys and belts
- Embellish your program or birds if time permits

Reflection

- What STEM learning did you experience? 21st Century Skills?

Curriculum Sequence

- 1 – WeDo - Getting Started, Dancing Birds
- 2 – Drumming Monkey, *Spinning Top*, *Ride Challenge*
- 3 – Amazing Adventures (ELA), Car Challenge
- 4 – *Soccer* (Math), Burglar Alarm Challenge
- 5 - NXT - Motors and Geometry
- 6 - NXT - Velocity and Dragster Challenge



Grade 3: Physical Science

3-PS2 Motion and Stability: Forces and Interactions

3-PS2-1. Provide evidence to explain the effect of multiple forces, including friction, on an object. Include balanced forces that do not change the motion of the object and unbalanced forces that do change the motion of the object. [Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force magnitude, only qualitative and relative. All descriptions of gravity are limited to a force that pulls objects down.]

3-PS2-3. Conduct an investigation to determine the nature of the forces between two magnets based on their orientations and distance relative to each other. [Assessment Boundary: Assessment is limited to forces produced by magnetic objects that can be manipulated by students.]

3-PS2-4. Define a simple design problem that can be solved by applying the use of the interactions between magnets.* [Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.]

[Note: 3-PS2-2 from NGSS is not included.]

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:

Science and Engineering Practices	Disciplinary Core Ideas
Asking Questions and Defining Problems • Define a simple problem that can be solved through the development of a new or improved object or tool. (3-PS2-4) **Planning and Carrying Out Investigations** • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-PS2-1), (3-PS2-3)	**PS2.A: Forces and Motion** • Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) (3-PS2-1) **PS2.B: Types of Interactions** • Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. (3-PS2-3),(3-PS2-4)

Grade 3 3-5-ETS1 Engineering Design

3-5-ETS1-1. Define a simple design problem that reflects a need or a want. Include criteria for success and constraints on materials, time, or cost that a potential solution must meet.*

3-5-ETS1-2. Generate several possible solutions to a design problem. Compare each solution based on how well each is likely to meet the criteria and constraints of the design problem.*

3-5-ETS1-4(MA). Gather information using various informational resources on possible solutions to a design problem. Present different representations of a design solution.* [Clarification Statement: Examples of informational resources can include books, videos, and websites. Examples of representations can include graphic organizers, sketches, models, and prototypes.]

[Note: 3-5-ETS1-3 and 3-5-ETS1-5(MA) are found in Grade 4.]

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:

Science and Engineering Practices	Disciplinary Core Ideas
Asking Questions and Defining Problems • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1) **Constructing Explanations and Designing Solutions** • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (3-5-ETS1-2) **Obtaining, Evaluating, and Communicating Information** • Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (3-5 ETS1-4)	**ETS1.A: Defining and Delimiting Engineering Problems** • Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1) **ETS1.B: Developing Possible Solutions** • Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2), (3-5-ETS1-4) • At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2) **ETS1.C: Optimizing the Design Solution** • Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-2)

Grade Level Specific LEGO Lesson

- Build and program grade level specific LEGO lesson. See Teacher's Guide and Heffernan book. Do experiment(s). See suggestions for grade 3.

Sample Open Ended Challenge

- Build an amusement park ride that is fun and safe
- Only use parts in your kit
- Use words and/or pictures to plan a ride
- 30-40 minutes
- "Mistakes" are progress

Reflection

- What STEM learning did you experience? 21st Century learning?
- How did this differ from the more structured activity?
- How did you experience the engineering design process?

Day 2 Agenda

- In grade level teams, try all grade level curriculum
- Logistics - parts management, scheduling, lab, curriculum, support
- Final reflection
- Clean up

Sharing Out

Final Thoughts?

- What is the most important tip you learned?
- What will be a challenge for you?
- How will this program benefit your students?

Resources

- jheffernan@verizon.net
- http://www.kidsengineer.com/

Materials List

- Handouts (slides, specific lessons - spinning top, dancing birds, soccer kicker, soccer goalie, amusement park ride)
- Post handouts
- Laptop and dongle and power cord
- Book
- Evaluation
- Sign In Sheet