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ROBOTICS FOR MIDDLE GRADES

(4-8)




Background

- Workshop work with Lego WeDo Robotics.
 - NASA/Georgia Tech. online course with Lego NXT Robotics.
 - Lego Education Advisory Panel (LEAP).
 - Does anyone remember Logo and Turtle Geometry?
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Workshops

- July 2012 – 4 days.
 - Five teachers – In-service and pre-service.
 - Fall 2012 – Additional Saturdays, add nine teachers.
 - Lego Mindstorms Education
 - NXT Base Set
 - Resource Set
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Mathematics-based Tasks

- Gear Ratios
 - Linear Movement
 - Turning
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Gear Ratios

- **Gearing down / slowing rate of rotation**
 - Driving gear (input): 8 teeth
 - Driven gear (output): 16 teeth
 - Ratio = $1 : \frac{1}{2}$ or $2 : 1$
- **Gearing up / increasing rate of rotation**
 - Driving gear (input): 16 teeth
 - Driven gear (output): 8 teeth
 - Ratio = $1 : 2$

Linear Movement

- Number of rotations of a wheel.
- Amount of time – Distance depends on battery life.
- Exact distance – Dependent on circumference of wheel.
 - $C = 18 \text{ cm}$ (approx.)
 - Problem: Move forward 1 meter.
 - $18 \text{ cm} / 1 \text{ rotation} = 100 \text{ cm} / x$
 - $x = 5.56 \text{ rotations}$

Turning

- Circle – Each wheel (motor) turns the same amount, but in opposite directions.
- How far? – $C = (\pi)d$, where C is the circle traced by one rotation of the robot, and d is the distance between the centers of the wheels.
 - For example, $d = 117$ mm
 - $C = 3.14 \times 117$ mm = 368 mm (approx.)
 - $R = 368$ mm / 18 cm = 368 mm / 180 mm = 2.04 rotations (of wheels)



Common Core State Standards for Mathematics

- Grade 4 – Multiplication and division, decimal notation, relative sizes of units of measurement, solving word problems involving distance and time, angles and angle measure.
- Grade 5 – Multiplication and division, decimals to thousandths, conversions within a given measurement system.
- Grade 6 – Ratio.
- Grade 7 – Circumference of circle.
- Grade 8 – Rotations (symmetry).




CCSSM Mathematical Processes

- Across all grade levels.
- 1. Make sense of problems and persevere in solving them.
- 2. Reason abstractly and quantitatively.
- 3. Construct viable arguments and critique the reasoning of others.
- 4. Model with mathematics.
- 5. Use appropriate tools strategically.
- 6. Attend to precision.
- 7. Look for and make use of structure.
- 8. Look for and express regularity in repeated reasoning.



Other Tasks

- Building sturdy structures.
 - Loops.
 - Sensors – Touch, sound, light, ultrasonic.
 - Robotic arm.
 - NASA and other online links for robotics.
 - Choice activity -
<http://www.nxtprograms.com/>
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Choice Activity

- Contains the building instructions AND the program.
- Example – Snowmobile Race
 - Two "snowmobiles" race each other in a circle around the NXT brick.
 - One of the snowmobiles goes faster than the other one by using different gears.
 - The slower one has the "inside lane" because its cord is shorter.
 - Which one will win?

