Robotics Course Outline

Below is a general outline of content covered in a robotics electives class. For a class that meets for 45 minutes every day, you will probably not cover all topics here. I mark where I generally end the school year.

Throughout the curriculum content supplement with design challenges you find. Use resource books such as Mayan Adventure, online sources such as nxtprograms.com, GEAR competition challenges, and non-LEGO robotic lessons such as End Effector from NASA. The sky’s the limit!!

This upcoming school year the regular curriculum will be supplemented with the GEAR design challenges from the summer professional development. With each design challenge, there will also be a project based learning focus with more research, documentation of using engineering design processes, writing and presentation skills.

What is engineering? – Timeframe: 1-2 weeks
- have students do a research project on the different engineering fields – mechanical, electrical, civil, aerospace, etc.
- use simple building challenges (i.e. activities from KLUTZ Lego Contraption book)

What is a Robot? – Timeframe: 1-2 weeks
- What is a Robot PowerPoint (workshop materials)
- discuss what is needed in a system to classify it as a robot
- analyze items around classroom or home environment and determine if it’s a robot
- have students sketch and write about what they would like to have as a personal robot
- lead class discussion or student research project on the history of robotics
- discuss ethics and how they relate to robotic technology

Design Journal – Timeframe: 1 week
- discuss engineering process – FRAME (Texas Tech version), 5 E model, NASA engineering process, etc.
- create a design journal and lead class discussion of importance of brainstorming, sketching, and documenting work on challenges
- discuss and practice flowcharting skills

Kits/LEGO pieces – Timeframe: ongoing
- identify specific pieces within kit – plates, bricks, technic beams, gears, etc.
- makes a great bell ringer activity – have a slide on the board of several pieces each day for students to identify
First Construction – Timeframe: 1-2 weeks
- with no instruction, have students create their own robotic car
- set up a series of tests to analyze sturdiness and capabilities of car
- discuss stability and construction techniques for stable robots (several online sources available to give specific examples)
- have students build the base model from the construction booklet in kit – make sure to discuss language of the construction book and how to read it before students start construction

NXT – Timeframe: 1 day
- class discussion on the different menus on the NXT brick and how to manipulate through each one
- Try Me Menu on the brick is a fun way to introduce sensors
- NXT program – can use this function to write a 5 step program without the software to have models run basic movements (forward, backwards, turn, sound tones, etc)

Basic Programming – Timeframe: 3-6 weeks
- software overview – walk the students through all the parts of the software, determine if you will use the common or complete palette and walk students through each menu option, discuss NXT window and how to locate specific NXT brick, delete programs, clear memory, etc
- write basic move forward and move backwards programs – explore in configuration panel the duration of each block (unlimited, rotations, time, degrees) and how it affects the movements
- write basic turn programs – explore steering option in configuration panel and how it affects movement of robot – explore using the MOVE block to run multiple motors on one brick to MOTOR block where only one motor is moved at a time
- explore through the VIEW menu on the NXT how to measure rotations and/degrees for straight distances and turns – have students create a chart showing specific rotations needed for the robot to make a right angle, a 45 degree angle, etc – use this as reference throughout the year
- example challenges to be run after basic programming – DinoBot, Measure Turns, Parking Space, RoboRacer, Shape Factory, Stop for Pedestrians, Wheels and Distance, certain challenges within Mayan Adventure book and GEAR competition also use basic programming – (all individual challenges in workshop materials)
The Fun Stuff Programming – Timeframe: 1 week

- discuss how to program displays, sounds and loops – explore configurations in each of these panels
- example challenges to be run after programming – Meet and Greet (workshop materials)

Sensors – Timeframe: 2- 4 weeks

- introduce each sensor – use the TRY ME menu on the NXT brick to show how each functions
- explore the VIEW menu on the NXT brick to show students how to collect readings for each sensor
- program using the touch sensor – explore the configurations
- example challenge – Obstacle Course, Living on the Edge
- program using the sound sensor – explore the configurations
- example challenge – Clap On, Clap Off
- program using the ultrasonic sensor – explore the configurations
- example challenge – modify Obstacle Course, Where’s the Cheese
- program using the light sensor – explore the configurations – students will also need to be introduced to the SWITCH block at this point in order to complete a line follower program
- example challenge – Line Follower, Edge Detector
- add sensors into other design challenges such as GEAR competition or Mayan Adventure book
- all challenges are found in workshop materials

Gears – Timeframe 2-3 weeks

- discuss how they work and what is the result of each gear train
- calculate gear ratios
- create a robot car that incorporates gears into the chassis
- example challenges – The Tortoise and the Hare, Mountain Rescue, Peak Performance, Ramp It Up, Tow Truck
- all challenges are listed in workshop materials

Datalogging – Timeframe: 2-3 weeks

- introduce datalogging section of software – run a live program (the NXT brick is connected to the computer, stationary and just collecting data) – walk students through how to manipulate graph and use analysis
- use datalogging ideas in the Robot Educator section of software to have students run remote programming – show lines crossed, find distance, object detection
- have students create their own datalogging programs and/or search of activities online or in resource books
LEGO based competitions – Timeframe: 6 weeks
  • most competitions are run in the spring
  • look into TCEA competition, First LEGO League, GEAR, etc

By this point….the end of the year is looming and I end with a final project. These are sometimes teacher generated...create and program an amusement park ride, create and program a mini-golf course hole, etc. Sometimes these are student generated. Then we hold a robotics fair at the end to showcase all projects.

Advanced Robotics

Construction Challenges
  • students create robots that are more complex in construction – i.e. STRINGbot from Mayan Adventures
  • creations from websites such as nxtprograms.com

Advance Programming Skills
  • walk through each of the following blocks and then have students complete a design challenge that would use each one
  • LOGIC – Simon Says (Applied workshop)
  • MATH – Sound Sensor Meter (Applied workshop), Light Symphony (Applied workshop), Applause Meter (Applied workshop)
  • COMPARE –
    • VARIABLE – Voting Booth (Applied workshop), Cross the Lines (Applied workshop), Edge Detector (Intro workshop)
    • NUMBER TO TEXT – Lottery Counter (Applied workshop)
    • RANDOM – Lottery Counter, Simon Says (Applied workshop), Random or Not (Applied workshop)
  • Create MY BLOCKS and use within programming

Again...this by no means is a complete list. My topics and/or challenges change each year as I find new ones or too many problems in the old ones. Look into other resources and have fun planning your course! Good luck and please contact me with any questions.

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