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Context and Rationale
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Introduction – synopsis

STEM is an acronym for Science, Technology, Engineering and Mathematics. When people talk about STEM, the conversation could only be in terms of STEM itself. STEM is largely used and exceptionally blended into our culture. Now imagine 15 to 20 years from now, when robots drive majority of today's workforce. According to Okita (2014), not just with industries or manufacturing, but also with artificial intelligence that can feel, move, teach, and even perform surgical operations. The medical robots are already being used with surgical practices and procedures. Robots offer assimilated performance that is driven with precision that can create mechanical organs, and different respiratory systems.

Living on the reservation for over 20 years, this kind of thought is not far from futuristic thinking for our students. Thinking about how robots are going to influence the potential workforce, how are we getting our students prepared for futuristic careers? In this curriculum development I will be comparing robots to the human body, related to Diné-Navajo teachings.

When students enter my classroom, they instantly think about how "Cool" it is to learn about software coding, and robotics. Students get engaged with different robots already set up in my classroom. Without pointing out the EV3 Lego Mindstorm robot that looks like a human, they start to ask questions. What does it do? Can it speak? Can it shake hands? Can we tell it what to do, like do my homework? After asking questions, I go into detail about what robots are called and what they are used for. I introduce the EV3 robot as, "Billy Frybread" who also has four clans. Although they laugh and joke about the robot, I know I have captured their interest.

Navajo-Diné Kinship is called "ké", clans identify where you are coming from and which family you are representing. Clans also express self-identification and connection. To show a cultural connection with students, I had given a unique Navajo-Diné Name and four clans to the Robot displayed in my class and to treat it with respect, because it's an elder robot. To engage student's interest in robotics, I start with an immersion story of the robot that is similar to Navajo-Diné introduction.
Navajo-Diné stories are also essential to our culture, so I have stories of where the robot came from and how it's been developed similar to the origin story of emergence for Diné.

To embrace and adapt to Navajo-Diné customs, I also compare the condition of the robot that is similar to the well-being that can introduce the spiritual, emotional, social, and physical well-being of the biology of human body. The emotional well-being is described as the state and health of mental fitness. The emotional well-being is when students realize their own abilities, and their own thinking through processing complicated information. Problem solving skills is also communicated through, assessment preparation, creativity, and can be determined through emotions that generate positive outcome.

The social well-being is linked when students personal performance is connected to perseverance that challenges their abilities, through hard work, and difficulty. Students also build social well-being through interactions with peers, community, and build strong relationship with teacher to help support student educational success. Furthermore, social well-being is creating a community family like learning environment so students feel a sense of belonging.

For Diné-Navajo, spirituality is a balance of emotions, individual spirit, social, and physical health. It means to live through life with harmony, harmonization that is connected to forces of life, mother earth, fire, wind, and water. Native American fitness and health has been well reviewed and researched, the physical well-being can be influenced by many major factors within students environment. Native American fitness can be found as a personal diet that is high in saturated fat, cholesterol intake, and sodium. Before contact with Europeans, Navajo-Diné was considered free of diabetes, obesity, and heart failure. Today the same population of Navajo-Diné is revealed as poor health outcomes with escalation in hypertension, diabetic patients, and high in heart failure.

Demographics: place

I have been teaching for over 15 years, I currently teach at Chinle High School in computer science and programing. Chinle is a very special place that is embedded with countless cultural stories and located in the central part of Diné Nation. It is located at 5,500 feet in elevation. Chinle is known for the beautiful Canyon De Chelly, a National Monument that attracts many visitors from all over annually. In Navajo-Diné traditional cultural teaching, Canyon De Chelly is mentioned through stories, prayers, and songs by local practitioners in the Beauty Way Ceremonies.

According to the 2010 census report, the population is 5,698 with land range that spreads 16 square miles. The median age is 20.8 with 87% being Native Americans, 4% Hispanic, and 9% white. The economic status is $30,368 median household income, and 49% of the people are below the poverty line.

Chinle Unified school District No. 24 has seven schools, and over 4500 students district wide. Chinle Unified school district is the largest school district on the Navajo-Diné Nation, and 97% of student enrolled are Native Americans. Chinle High school serves students 9 through 12, the school alone has an enrollment of over 1300 students. School buses travel over 5,200 miles on routes each day and pick up students from nearby communities such as, Chinle, Many Farms, Tsaile, Luckachukai, Wheatfields, Nazlini, Cottonwood, and Tsélání.

Rationale - why

I love to make learning fun, and fuel young minds to think critically, analyze data, explore curiosity, and solve complex problems using computer science. Robotics and software programming is very complex just like the human body. Whether, students pursue careers in technology or not, computer science programming prepares students to be active, and to be informed about different technological societies. Programming is not just a skill, its life changing, and empowering. It's important to have students be curious, and express themselves through creativity. It's also imperative to provide a learning environment that is socially active. My class is a place where I encourage, open discussion, presentations, peer feedback and shared reflections.

Computer science is rapidly rising according to (Bureau of Labor Statistics, U.S. Department of labor, 2019) that offers a wide-range of occupations that provide essential rewards. Introducing 9-12 students to computer science through computer programming is currently the foremost significant educational reform with developing content specific course, such as cyber security, animation, gaming, and robotics, while majority of topics include coding with information technology and communication courses (Fallon, 2016). While many rural schools access increase to technology, gradually the uses of technology are expanding throughout curriculum in formal and informal learning environments. This expansion highlights a critical need to identify computer science pedagogy, and practices. Students presenting more than 50% of population on Navajo Nation being taught in rural areas have become increasingly more culturally and linguistically diverse with culturally relevant curriculum.

According to National Science Foundation, the benefits of learning programming language include the development of computational thinking skills, collaborative peer relationship, and STEM indigenous identities. Culture is defined as "a group's individual and collective ways of thinking, believing, and knowing, which includes their shared experiences, consciousness, skills, values, forms of expression, social institutions, and behaviors" (Fallon, 2016). I will be presenting material with cultural awareness, and calling previous experience, and cultural expression to make learning more relevant and equitable for my students that is empowering, transformative, and connected to core identities that is valued through Chinle District philosophy.

The reason why I am developing this curriculum unit is for my students to learn about the biology of the human body, and how it's similar to robotic humanoid mechanism. Particularly, I want my students to understand how humanoids resemble the muscular structure. My purpose is to explore with students the similarities between how robots move, and how humans move and walk using the muscular flexors. We all know some parts of our body, but majority also don't know how it relates to wellness and fitness, and have little to no knowledge about the structure of our own bodies, and what they are capable of. I participate in, half-marathons, and full marathons, and didn't really understand the chemical reactions within my own body. Recently, I found that Glucose reaches the muscles through the blood stream, and broken down, and more must be provided.

According to Webster's dictionary the meaning of humanoid is described as having an appearance or character resembling that of a human. A "robot" is defined as a machine resembling a human being and able to replicate certain human movements and functions automatically. A Robotic humanoid is a robot that looks like a human without being one.

Robotic software is coded with intricate set of commands or instructions that tell a mechanical device, electronic system, or artificial intelligence what to perform. A complex framework using software coding is used to execute self-directed robotic tasks automatically.

A humanoid robot is designed to look like a human, and function like one such that it interacts with humans socially. University of Tokyo has a team of robotic engineers that created a robot called "pepper", that has a head, body, arms, and legs similar to human body. The robot is engineered with sensors to sense surrounding with several motors that triggers the robots motion similar to human muscular system (W**ebb, 2001)**

Yale University, MIT, and Carnegie University are some of the educational institution that are exploring with robots. They are exploring how they can solve unique and advance problems using humanoid robots. In recent testing with students, they have found that robots can help students learn new skills, and promote good study habits that generate positive attitudes toward learning. Learning content that is delivered through a robot somehow makes their brains develop good study habits and makes learning fun, with this in mind robots have proved useful to make students lifelong learners **(Webb, 2001)**

Engineering model of robotics is similar to Diné-Navajo Philosophy. Engineering is essential part of constructing the robot. Navajo-Diné belief system has been created on traditional stories, songs, prayers, and ceremonies of its people. According to Aronilth (1992), the unique philosophy of Sa'ah Naaghai Bik'eh Hozhoon is the natural balance of: Nitsahakees – Thinking, Nahata – planning, Iina – life, and Sii Hasin – Hope or achievement. Thinking, planning, living, and reflection is similar to engineering process of problem solving.

After teaching robotics to 9-12 students this year, I observed how robotics could also provide meaningful connections, where students can apply complex framework to solve real-life problems. What I also observed is how the robotics program had a profound effect on student's growth in personal development, knowledge, and computational thinking, creativity, determination, and peer collaboration. The students are required to work in groups of 4 to 5, they engage with each other when they have trouble understanding the purpose and real-world applications.

Students learn about how movement results from the mechanics of walking and moving. Student will implement how decisions reflect muscle movement (human) through motors (robot). The curriculum meets the Navajo Cultural standards, CSTA, and Arizona computer science standards. **Need to describe how this curriculum meets these standards in the standards section later in this unit plan**

Content Objective:

In teaching this curriculum unit, I will teach students about muscles flexors and how it reacts to movement automatically without consciously thinking about muscle responses. The activities students will learn is to explore in depth about how muscles work in the human body.

Teaching students about the muscular movement, and structure I will use worksheet with pictures to identify them. The human body is made of four major parts, the sensors, the muscles, the brain, and the Nervous system. The muscles allow you to move around. Muscle sizes vary between people in length and thickness. The end of the muscles is connected to the bone by tendons. Tendons can be identified as a band of tissues that connects bones to muscles.

The EV3 brick or the intelligent brick is the heart and brain of the Robot that is programmable. The brick has six buttons that indicates active state, and the screen is displayed in black and white, has a built-in speaker, USB port, mini SD card reader, and four input ports and four output ports. The four input ports are for data processing of up to 1000 samples per/sec. The output ports are for execution of commands. The mini SD card reader is for expanded memory up to 32 GB. The brick also communicates through Bluetooth and Wi-Fi, and with a computer it can be programmed, and uploaded directly into the EV3 brick. It's fully compatible with free software that supports mobile devices, android, IOS, and apple.

The part of the robot that makes it move is called motors. The motors spin and cause the wheels to push off (force energy) the ground causing the robot to move similar to muscles. The motor of the robot moves similar to the muscles in the human body.

The mechanic and physiology of our muscular movement within our body, is like a machine. The human body mechanism involves the outflow of energy. This energy is projected from the muscular contraction that is generated from a series of chemical reactions with enzymes. The muscles itself is constructed out of protein, also called myosin that is 75% water (H_2O).

Would be good to compare the 4 human parts you identified (sensors, muscles, brain, and nerves) to specific parts of the robot to make the proper analogy between the two.

Human anatomy sensors

We humans learn about the world through different experience using our five sensors, touch, sight, sound, smell, and taste. The human brain,

Ears – the ear is an advanced and very sensitive organ of the human body. The ear's function is to transmit and convert physical vibration or sound and communicate with the brain. The ear is a mechanism to receive and transfer complex information. The transduction is performed by the delicate hair cells that initiate a nervous impulse. There are three parts of the ear, outer ear, middle ear, and inner ear and they all have different, but important job that facilitate hearing and balance (Scanlon, Valerie C., and Sanders, 2019).

The **outer ear** is called the auricle or pinna, this part of the ear is located at the loop of cartilage and skin that is attached to outside of the head. The pinna works like a megaphone and sound is funneled through the external ear. The tympanic divides the external ear from the **middle ear**. The middle ear is a small cavity lined with epithelium. There are three small bones in the middle ear, called the auditory ossicles (Scanlon, Valerie C., and Sanders, 2019). The three small bones that are connected transmit the sound waves to the inner ear. Sound waves entering the ear cause the tympanic membrane to vibrate. The ossicles carry the vibrations into the inner ear. The three bones move and pass on the vibration to a much smaller oval shaped window of the cochlea (looks like a shell), sound travels through and touches the window of the cochlea. The Eustachian tube, or pharyngotympanic tube in the middle ear equalizes air pressure in the middle ear. This process helps our body retain balance (Scanlon, Valerie C., and Sanders, 2019).

The **inner** ear function is to transduce vibration into nervous impulses. The nerve fibers can fire at a rate of just less than 200 times per second. Sound level information is conveyed to the brain by the rate of nerve firing. The vestibular complex, in the inner ear, is also important for balance because it contains receptors that regulate a sense of equilibrium. The inner ear actually uses little hairs that vibrate with the sound waves in fluid (Scanlon, Valerie C., and Sanders, 2019). The inner ear has fluid filled tubes that help with balance.

The **eye** is a spherical structure, surrounded by fat and has a number of protective structures. The eyelids cover the eye during sleep. The eyelashes and eyebrows protect the eye by removing small particles, deflecting air, and keep dust out of the eyes. Eyelashes have an average lifespan of five months. The main function of the eyes is to transmit light and visual information to the brain. The visual cortex, in the occipital lobe of the brain is responsible for processing visual information from the eye (Scanlon, Valerie C., and Sanders, 2019). The eye is lined with a thin membrane called the conjunctiva that can cause allergies that make eyes red, itchy, and watery. Tears are made by the lacrimal glands, located at the upper, outer corner of the eyeball (**Scanlon, Valerie C., and Sanders, 2019).** They eye has many parts that all cooperate together to give us visual images. The sclera the white part of the eye protects the eyeball. The pupil is the centre of the eye that carries light through the center. The iris the coloured part of the eye surrounds the pupil and controls how much light enters the eye by changing the size. The cornea the clear window at the front of the eye covers the iris and the pupil (Scanlon, Valerie C., and Sanders, 2019). The clear lens, which is located behind the pupil, is like a camera and focuses light onto the retina at the back of the eye. The retina is a thin layer of tissue that covers the back of the eyes and the inside. The retina is located near the optic nerve. The purpose for the retina is to receive light.

Learning the anatomy of the nose can help anyone understand how the nose works. **Nose** on the human body is essentially a sense of smell. Molecules from the smell have to make it to your nose. How? Everything we smell are molecules, those molecules are generally light, volatile chemicals that float through the air and into our nose. The mucous membrane is thin tissue thin line the nose, sinuses, and throat and at the top of our nasal passages there is a patch of unique neurons and these neurons open and come in contact with the air. Smell is like taste and the sensory cells are called chemoreceptors (Scanlon, Valerie C., and Sanders, 2019). The nasal cavity is a hollow space behind the nose that air flows through. The septum is a thin “wall” that is supported by the cartilage and bone.

The human **mouth** is the start of the digestive region, however we will focus on the taste and speaking of the mouth. The tongue helps with tasting food and speaking. Lips are part of the mouth and made up of muscles and mucous membrane. A muscle called the “orbicularis oris” causes the lips to open and close (Scanlon, Valerie C., and Sanders, 2019). The lips is part of how we speak, and form sound out of many words and letters, such as vowels sounds and different consonants.

Robotic Anatomy

What are sensors and how a robot utilizes sensors? Robots can’t actually see or feel like humans, however when sensors are added to robots they can collect and report information about the environment. Your program downloaded into the brick, can interpret sensor information in ways that will make your robot seem like it’s responding to its environment, as if it’s actually experiencing it. Data from sensors feeds the brick information about its environment. A program uses that data to make decisions, and the robot acts on decisions. **Data is the core** of the entire process (Nourbakhsh, Crowley, Bhave, Hamner, Hsiu, Perez-Bergquist, Richards, and Wilkinson, 2005).

Brains of the robot is called the intelligent brick, programs are executed from the brick. Programs are downloaded to create movement and have the robot respond to different sensors attached. The brick sends programmed information to motors, and receives detailed information from sensors to initiate the programmed parameters. **(**Nourbakhsh, Crowley, Bhave, Hamner, Hsiu, Perez-Bergquist, Richards, and Wilkinson, 2005).

An ear of the robot is called sound sensors or the ultrasonic sensor, and captivates the data of sound waves. The sound sensor is capable of measuring the loudness of the robot’s surrounding environment. Using the sound wave of the lego mindstorm the robot can move or flee to areas of lower or higher sounds (Nourbakhsh, Crowley, Bhave, Hamner, Hsiu, Perez-Bergquist, Richards, and Wilkinson, 2005).

The sound sensor

Eyes of the robot, is called the **ultrasonic** sensor, and it measures the distance between other objects. The brick retrieves the information from the ultrasonic sensor and uses it through measured programs.

Hands of the robot is called the **touch sensor**, it can detect an object when the red button at the bottom is touch or push. The Touch sensor can be programmed to action using pre-set conditions, pressed, released, and bumped.

Large motor is a powerful “smart” motor. The motor has built-in rotation sensor with 1-degree resolution for precise control. The large motor is used with “move steering or move tank” programming block in the EV3 software, the large motor together will coordinate the action at the same time.

Wires connect the motors and sensors to ports to the brick using wires. Wires should be connected into specific ports that correspond for that part of the robot. The wire cable serves as the nerve of the robot. Through the cable messages and information is sent to the brick.

What is a robot?

Robots come in different shapes, sizes, tasks, field, and programming languages. To build the background knowledge for students, we review the differences between robots and how they are used.

Industrial Robots are used in factories or a manufacturing environment. The robot is designed for loading/unloading and placed with automated controls, and reprogrammable. This type of robots is specifically designed to perform tasks with high precision without taking a break, and helping manufacturers increase output. The robots are used in food packaging, arc welding, spot welding, material handling, machine assembly, automotive assembly, adhesive applications, and electronic assembly. Implementing an industrial robot in businesses, one needs to understand the types of robots for their operations and factor in load, speed, and precision.

Domestic or household robots are used in home. These types of robots are devices such as robotic vacuum cleaners, pool cleaners, floor cleaners, cat litter robots, robotic pets, social robots and security robots with night vision that detects motion and shoots video of suspicious activities that can send via email or text messages.

Medical robots are used in medicine or medical institution. Operations in surgery can be done with just a few tiny incisions and with precision, which means faster healing, less bleeding and reduced risk of infection. The field of prosthetics as advanced its technology with robotic arms, and replacement for a limb that can be controlled like a normal limb.

Service robots are designed to deliver food, and can operate semi-or fully autonomously to perform service that is useful to well-being of humans and equipment, excluding manufacturing operations. Service robot are used for mankind on a daily basis. They can assist disabled people, fight fires and defuse bombs.

Movement: the robot operates on sequence commands to make it move and turn. **Decisions:** use loops and switches to control the program with smarter decisions.

Software, firmware, and hardware

Software is used to create the program, which is a set of instructions or sequenced programs instructing a computer to do specific tasks. The theory of software was first introduced in 1935, by Alan Turing when he mentions the word in an essay of computable numbers with an application. Moving forward 23 years in 1958, **John Tukey** mathematician and statistician formulated the word software as he referenced an electronic calculator. The word "*soft*" part of the word software comes from the ability to make changes easily. This flexibility of creating unique programs allows you to create endless variety of sequence programs using only the EV3 brick, sensors and motors.

The program can be downloaded from computer to brick, programming a Mindstorm is completed through a flowchart language called Robolab, based on the language specification (Coxon, 2012). The programming simulates a flowchart design that allows the robot to perform different operations simultaneously and autonomously.

Teaching Strategies

The teaching strategies that will be used are as follows. Teaching strategies are utilized to enhance the quality of instruction and to make the lessons most effective for student performance outcome and mastery. Teaching strategies used are effective to promote positive student learning environment and help keep students engaged with the lesson.

Interactive Teaching: I will be using this strategy while I model and interact with student learning process. I will use hands-on demonstrations and exercise. Student's knowledge will improve and their interest, strength, knowledge, team spirit and creative expression will increase.

Pair programming can solve issues quickly when two students are working together. **Pair programming is about** two students practice collaboration through programming as a team. One programmer acts as the driver who writes the code, the other programmer acts as the navigator who examines code and provides information and instructions. Both are held accountable for giving and switching off roles in equal intervals. As the students learning experience increases students are encourage to share and practice techniques to solve problems.

Think pair share is a great teaching activity when you want students to express their reasoning, and understanding about their learning progress. Students are encouraged to think individually about the topic then in pairs and finally as the whole class. As a teacher, creating a safe learning environment is empowering, and allows students to collaborate to solve problems and have a clear understanding of content being taught. Think pair share allows students the opportunity to communicate and have fun with simple questions and keeps students engaged.

Small group helps provide students with a reduced student-teacher ratio, and typically made of two to four students. Small group instruction allows teacher to work directly with each student on a particular learning objective. The teachers focused attention is given to students with small group instruction. I see the value with small group instruction with learning and behavior needs, this approach is beneficial to improve the student-teacher ratio.

Whole group instruction is given as a whole group or as a whole class. This type of instruction helps the teacher with students who are struggling with concepts and take another approach and use different strategies for instruction.

Hands-on design tasks, computer science is about hands-on approach of programming and creating, developing, and solving computational problems. Creating and developing program with hands-on learning experiences with developing strong programming skills like sequences, loops, conditionals and operators are embedded in key content of computer science.

Scaffolding challenges students through deep learning and discovery. Scaffolding for students supports the students learning environment. Students are safe to ask questions, provide feedback and support each other with new learning materials. Teacher's role through scaffolding is moving beyond their current skills and knowledge. Teaching though scaffolding student's understood they are able to take ownership of the learning environment.
The first step through scaffolding is when the teacher models how to perform a certain task.

Differentiated instruction: give student choice and have them select their two robots and research the different jobs they assist with and perform. Have students compare as they build background knowledge.

Activity

Introduction to programming with EV3 robots provides students with structured sequence of programming activities in real-world and culturally relevant contexts. The planned activities are designed to get students thinking about the patterns and structure of programming and problem solving in generally. This portion of activity is to get a new user engaged in EV3 background, maintenance, and getting to know how robots are utilized. By the end of the curriculum, students will be able to problem-solve and learn basic concepts of programming commands and sequences. The curriculum is design to give students experience and access to different perspective and attain computational thinking. Before getting to day 1, teacher should go through EV3 batteries and update firmware prior to using the robots with students. Below is a brief outline of the following days with students utilizing the Lego EV3 robotics.

The outline of Robotic is as follows and should be taken to account that these lessons throughout the unit is more than 5 days. Lessons are designed to be completed in 60-90mins, however this will vary base on student's age and ability. All lesson plans have been designed to highly engage student's interest in STEM education.
Preparation for teacher, read the LEGO guide for a clear understanding of the project and process you have chosen for your class. Create an inventory for parts and different pieces in each LEGO box.

The scope and sequence of the robotics, includes academic skills to component designs in a project-based learning environment and the design implementations is designed for two to three months, for the purpose of this lesson the design and sequence shall be the duration of 5 days. Additionally, students will explore career opportunities, employer expectations, and an educational needs in the robotic and automation industry. Below is also a sampled lesson plan for the unit.

- Unit 1: Robotics introduction
  - 1.1: What is a robot?
  - 1.2: Introduction
  - 1.3: Kit Inventory and overview
  - 1.4: Parts Exploration
  - 1.5: Instruction to Gears and motors
- Unit 2: Hardware, Software, Firmware
  - 2.1: Microprocessors
  - 2.2: EV3 Firmware
  - 3.3: EV3 Hardware
  - 3.4: EV3 Software: Programming
  - 3.4: EV3: Using the programming canvas

Day 1- What is a robot?

Intro to robotics LEGO EV3 Mindstorm, in this lesson student will be able to understand the history of what robots are used for. The objectives should be listed for students culturally relevant for student understanding.

Day 2- different robots of the world and uses
Day-3 getting to know your robot Anatomy

Day 4- Building and constructing your EV3 robot with multiple plastic and metal kits. You will learn how to build EV3 robot

Day 6- introduction to programming

Day 1 – What is a Robot?

Intro to robotics LEGO EV3 Mindstorm, in this lesson student will be able to understand the history of what robots are used for. The objectives should be listed for students culturally relevant for student understanding.

Standards:

Purpose objective:

Nitsahakees (Thinking): East – I am learning how to evaluate what a robot is and what it's used for.

Nahata (planning): South – I will show that I can do this by being able to identify how robots have advanced over time, and evaluate how robots are used in different industries and businesses.

Iina (life): West – To know how well I am doing this I will define what a robot is and identify the differences.

Sii Hasin (Hope): North – It is important for me to know this because…

- Define what a robot is and identify the anticipatory set for the upcoming lesson.

Anticipatory Set – Hook

Ask student prompt questions: what is a robot? Where did the term 'robot' come from? Name some types of different robots? Know that there are many different interpretations of what a robot is, accept all the differences and student responses.

Focus/Purpose Statement

Today we will be learning about what a robot is, where and when it was developed and why. Teacher should read the daily objective to students.

Procedures:

1. Engage students by asking them what they think a robot it. Discuss what students know and believe about robots.
2. Distribute paper and colored pencils, and ask students to draw a picture of a robot using their imaginations. What does a robot look like? What is it used for?
3. After students have completed their drawing, ask them to look at the robots they have drawn and consider the following questions:
   - How does your robot move? Does it talk? Does it have arms? If so, does it have joints? Where
   - Does it have any other moving pieces? How and where do they move?
   - What is the purpose of your robot?
   - Does it think? If so, how? What does it think about? Why?
4. As students start to think differently about their drawings, walk around the room and talk to each group individually, asking more questions about their drawing.
5. Ask students to think like an engineer or a scientist and no idea is bazaar as students think more analytical and draw more details about their robots.
6. Think, pair, share: with your shoulder partner at your table, share your robot drawing and features, give students A: 2mins to share, and student B: 2mins to share their creative drawing.
7. Come back as a whole class and use cold call strategy and have student share out their drawing.
8. Use computer with projection to show students a variety of advanced robots. Ask students how they think these robots move and are powered.
9. Ask students to visualize how their own arms, legs, eyes, thinking, feelings, and feet are in sequence with one another.
10. Ask students to look at their robot drawings again and think more about their designs, thinking about their own molecular movement and thinking process.
11. Have students share what they might do differently now that they have seen pictures of other robots.

Differentiation:

Closure:

Exit ticket: is it artificial? How do you know if something is a robot? What is the purpose of a robot?

Alternative closure: after they have finished their robot, have them write an imaginative story about their robot on a separate sheet of paper.

Materials and Resources:

Classroom Management:

Students will be organized into collaborative groups and so student will be working with other peers. For those students who refuse to participate and help group, come up with alternative worksheet or surface area problems for them to practice instead of working with manipulative.

Formative Assessment: informal during the lesson

During the lesson I will be walking around checking for students understanding and asking questions.

- Check for understanding and student frustration.

Formative Assessment: At the end of the Lesson

Prepare the history of robots for students and have students draw and write about what a robot mean to them. Introduce students to the Lego EV3 through Navajo cultural standards of identification. Guide students into teams and assign roles. Activate communication between members and assemble crew with roles and responsibilities.

Have student write and reflect on what they will be able to design after powerpoint presentation of what a robot should look and do. Student should journal the process and check for understanding through journal and asking prompt questions.

Checking for understanding questions:

Day 2– different robots of the world and uses.

Content Standards:

Instructional objectives:

Nitsahakees (Thinking): East – I am learning how to
Nahata (planning): South – I will show that I can do this by
Iina (life): West – To know how well I am doing this I will..
Sii Hasin (Hope): North – It is important for me to know this because…

Prior Learning/Thinking

Anticipatory Set – Hook

Start off with the lesson very informally, asking students questions about prior learning and summarizing the lesson from previous day. Organize the students into the groups they will build the robot with. Then, hand out the materials and the directions to each of the groups.

Focus/Purpose Statement

Today we will be learning about the many reasons that robots are used in society, pose the questions.
Name some types of robots? Why do we have robots? What function do they preform in society?
What advantages are achieved by having robots in certain situations?
In the real-world you may have limited material when you are creating something and you will need to know how to determine how much material you have used.

Procedures:

1. Pose the question
2. Explore different robots that are used in entertainment, transportation, art, social, space, medical, home, public safety, farming, and military robots.
   Public safety robots are used with criminals; some are used during hostage situations, and with defusing bombs.
   Military robots are designed to keep people away from harmful situations.
3. Robot operators can drive a robot into an unsafe area, and use the sensors and cameras on board to gather information.
4.
5. Explain to students that people that live in Chinle or surrounding areas are having a hard time with police showing up on time from one location to the next spreading an area of over 80-100 miles apart per emergency calls.
6. Think, pair, share: Question: What kind of robot do you think would help the police department do their jobs more efficiently? Why?
7. Students should share out ideas about the topic. As students share ideas create a mind map of all the different ideas generated. Explain this is collaboration and you are allowed to use other people's ideas.
8. Show students the modeled robot. This model robot should be assembled before lesson starts. To start the robot, press the middle button to startup.

Differentiation:

This project easily lets students differentiate by themselves.

Closure:

Materials and Resources:

Classroom Management:

Students will be organized into collaborative groups and so student will be working with other peers. Split the groups into team of five or six, groups should be mixed ability and each team can then be given one of the LEGO boxes to explore.

For those students who refuse to participate and help group, come up with alternative worksheet or surface area problems for them to practice instead of working with manipulative.

Formative Assessment: informal during the lesson

Strategies of using (who, what, how, when) probe questions: has anyone already done some programming or used Lego Mindstorm?

Formative Assessment: At the end of the Lesson

Day 3– Getting to know robot anatomy with connection of your own senses.

Content Standards:

Instructional objectives:

Nitsahakees (Thinking): East – I am learning how to
Nahata (planning): South – I will show that I can do this by
Iina (life): West – To know how well I am doing this I will..
Sii Hasin (Hope): North – It is important for me to know this because…

Prior Learning/Thinking

Students should be aware of the challenges the robot is going to solve.

Anticipatory Set – Hook

What are the main components of a robot?
https://youtu.be/1H5e8Vchh_w

Focus/Purpose Statement

Today we will be learning about the given equipment to design a robot that can mimic a specific body part by features of the following characteristics.
How the robot mimics human motion and providing a minimum of 3 degrees of Freedom (DOF)
How the robot mimics function, such as gripping, eating, kicking, smelling, tasting, earing, etc. using a combination of inputs from at least two sensors.

Procedures:

1.
Questions: important questions to think about
What do you want the robot to do, what is the robot's main function?
What sensor will help achieve this goal?

Differentiation:

Closure:

Students should begin to think about how they will program LEGO EV3 robot. Programming can be a difficult task for some students, students should be given a flow sheet provided with their LEGO box to help scaffold their algorithms.

Materials and Resources:

LEGO Mindstorms EV3 Kit
Mindstorms EV3 Stoftware
Detailed list of inventory and equipment used with building robot

Classroom Management:

Students will be organized into collaborative groups and so student will be working with other peers. For those students who refuse to participate and help group, come up with alternative worksheet or surface area problems for them to practice instead of working with manipulative.

Formative Assessment: informal during the lesson

Formative Assessment: At the end of the Lesson

Students will be able to compare the human senses to the electronic sensor in a robot. Introduce the programming language with sensors and navigate through sensors and how it relates to human senses.

Identifying the sensors and how it relates to human body, Touch sensor, how might you use touch sensor to let the robot know there's and object around or bumped into. Students are expected to learn about the structure of the brain, ears, eyes, nose, mouth, and hands. Students learn about the functions of its parts, and how the parts work. The lesson starts with an introduction to the different parts of the ear by showing students a model of the brain, ears, eyes, nose, mouth, and hands (**appendix 4)**; both English and Navajo. The task requires students to match the names with their parts.

Explain the touch sensor of the robot and go through with hands-on and identify parts of the robot. Introduce color sensor and how you robot use color sensor? Have students journalize and pair share with shoulder partner about responses. How does the robot use the ultrasonic sensor and how does it relate to human sensors? In what way do humans determine distance and balanced? Introduce ultrasonic sensor with robot and why they have sensors.

After the lesson have student describe the five human senses relate to robotic sensors? How sensors communicate with the brick (the brain of robot) and how human can relate or the same. (Compare and contrast) journal.

Students set up the robot and assemble the EV3 and learn about it's basic maintenance and structure. Students will identify what the parts are in the robotic kids and how the EV3 brick (memory brick) works. Students will install the EV3 program software to analyze the programming process. Student will connect and understand how sensors work and create program and robots for utilization of different sensors.
Students will be able to use problem-solving skills to design and build robots to maneuver through the challenging courses. Students Build and connect required pieces to each port. The EV3 is featured with a technology called "autoID" that allows the brick to automatically detect, identify, and configure hardware plugged in. the feature also has the capability to locate and identify any motor and sensors plugged in.

Journal entry for students prompting questions, what parts are available to build a robot, identifies parts of the robot with labels on worksheet. What types of sensors exits on robot and how are they important with programming. What kind of data would be appropriate to gather from sensors?

Day 4 – constructing your robot and getting to know the motors

Standards:

Purpose objective:

Nitsahakees (Thinking): East – I am learning how to
Nahata (planning): South – I will show that I can do this by
Iina (life): West – To know how well I am doing this I will..
Sii Hasin (Hope): North – It is important for me to know this because…

Prior Learning/Thinking

Anticipatory Set – Hook

Focus/Purpose Statement

Today we will be learning about
In the real-world you may have limited material when you are creating something and you will need to know how to determine how much material you have used.

Procedures:

1.
2. after student have designed a robot and can justify why this will help the local people, they should then list all the motors and sensor they thing they will need.

Differentiation:

Closure:

Materials and Resources:

Classroom Management:

Students will be organized into collaborative groups and so student will be working with other peers. For those students who refuse to participate and help group, come up with alternative worksheet or surface area problems for them to practice instead of working with manipulative.

Formative Assessment: informal during the lesson

During class time, I will be walking around to groups talking to individual students finding out how well the students are applying the material to scenarios and asking questions.

Formative Assessment: At the end of the Lesson

Questions: how are you going to make the robot stop in the right place?
Does your robot need to turn around?
How are you going to make it turn to the right place?

Assessment plan

Formative Assessment:

Observation – maneuvering through the course, watch and identify aspect of the brick building.
F**eedbac**k – give feedback in relations to learning goals and what they might do better.
Questioning: assign reflective questions for lesson review, students answer the reflection questions for lesson individually,
Grades – will record grades on progress and participation
Group Activities
Check for understanding:

Bell work:

Exit Ticket: Each student will be given a ticket to complete before leaving classroom. This is one strategy I use at the end of class. The exit tickets has open ended questions and fill out before students leave the class.

Journals/logs: document their solutions and explain how they overcame the key problems identified at the beginning and end of the curriculum

Summative Assessment:

Multiple choice 10 questions assessment

Rubric – A scoring guide using rubric **completion of all space challenge projects** with correct results within the allotted time. Student can evaluate their project work according to the learning targets, rubric is designed to help students reflect on what they have completed that is related to learning goals.

Modifications:

Students with special needs: student's hands on activity, cooperative learning, peer tutoring, extended time, reteach in utilizing various methods.

English language learners:

Provide hand-on activities and explanations

Use reduced text, so that print is not dense

Assess comprehension through demonstration or other alternative means (gestures, drawings)

- Give instructions/directions in writing and orally
- use of translation dictionaries to locate words in the Native Language

At-Risk students: hands on activity, cooperative learning, reteach in various methods.

Gifted and Talented Students: student will write their own program and build robot. Provide extension sensor activities per student interest.

Teaching standards

9-12 **Dine cultural Standards** – Concept 3 – Iiná – I will implement and recognize the Diné lifestyle

Connects with foundation and roots of Navajo human body

Career and Technical Education Standards: (48.0500.20) – Automation and Robotics

10.0 Perform Sensors and Control systems tasks

10.1 Select actuators and sensors for use in a feedback control loop

10.3 Calibrate sensors and actuators

4.6 Describe how sensors are used in robotics (e.g., robot arms, legs, steering)

7.1 Measure robotic performance against specified criteria

11.0 Develop robotics software

11.1 Develop a flowchart for software development

11.2 select a programming language for a robotics application

when students are programming EV3 robots to move

Understanding the structure of the physical environment, the interrelated components of robot hardware and software, and commands within a program are vital to successful solutions

Materials and Resources

- A good pdf (slide format) on the basics of NXT Programming can be found at: http://admin.robofest.org/2010/NXTG10.pdf
- Tufts University LEGO engineering resource site: http://www.legoengineering.com/
- A robotics resource using LEGO (from Tech Start Education Foundation of Oregon.) LEGO NXT tutorial. http://webclass.superquest.net/sboost/tutorials/NXT_Tutorial/index.html
- Carnegie Science Center of Pittsburg has a website called Roboworld that contains educational resources, workshop opportunities, and a section on careers in robotics. http://www.visitroboworld.com/visitroboworld/about.aspx
- Lego Engineering website - www.legoengineering.com
- NASA Robotics – http://robotics.nasa.gov
- The Lego Mindstorms EV3 book: The art of Lego Mindstorm EV3 Programming
- Programming – Hour of code – http://code.org

- Programming - Raspberry Pi – www.raspberrypi.org/
- Programming scratch – https://scratch.mit.edu/
- Programming – RobotC – www.robotc.net/
- Navajo Dine’ Education Standards
- National Science Standards
- Arizona State Technology standards
- Tablets (ipad, Android, Windows) with HTML5 browsers for accessing program APP and downloading program to Brick.

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Large Motor 	• Receives programmed instructions from the Brick. • Heavy duty with lower gearing for mobility requirements.
Medium Motor 	• Receives programmed instructions from the Brick. • Used primarily for moving parts of a robot. • Light duty with higher gearing for quick response; NOT suitable for mobility.
Color Sensor 	• Detects color differences and sends that data to the Brick for possible action according to programmed parameters. • Emits a set of color wavelengths. The color wavelength that is reflected back, and not absorbed, determines the color of the surface. • NOTE: sometimes, what appears to be a certain color to our eyes, may reflect differently to the sensor and cause unexpected results.
Ultrasonic Senor 	• Detects distance to an object and sends that data to the Brick for possible action according to programmed parameters. • Using the same principle as Bats and submarines, it uses echo location by emitting an ultrasonic wave that is received back after bouncing off an object. The time it takes to be received back determines the distance to that object.
Touch Sensor 	• Detects when red button is pressed or released • Sends the state of either being pressed, not pressed, or bumped (pressed, then not pressed) to the Brick for possible action according to programmed parameters. • Often used to determine if the robot has physically bumped into something.
Gyro Sensor 	• Detects the robots orientation and rotational motion and sends that data to the Brick for possible action according to programmed parameters
IR (Infrared) Sensor and IR Beacon  	• The IR Sensor detects proximity to other objects much like the Ultrasonic Sensor and sends that data to the Brick for possible action according to programmed parameters. • Also detects IR signals from the Beacon. • Beacon can be used as a hand-held remote control.

Lego Mindstorm Inventory Sheet

LEGO mindstorms education EV3

LEGO® Element Survey 45544

10x
Bushing, ½-module, yellow
4239601

10x
Bushing, 1-module, gray
4211622

60x
Connector peg with friction, 2-module, black
4121715

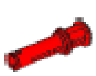
10x
Connector peg, 2-module, gray
4211807

8x
Connector peg with axle, 2-module, beige
4666579

6x
Connector peg, 3-module, beige
4514554

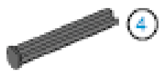
20x
Connector peg with friction/axle, 2-module, blue
4206482

30x
Connector peg with friction, 3-module, blue
4514553

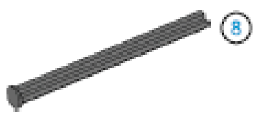


22x
Connector peg with bushing, 3-module, red
4140806

2x
Axle with stud, 3-module, dark beige
6031821

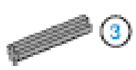


2x
Axle with stop, 4-module, dark gray
4560177

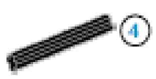


2x
Axle with stop, 8-module, dark gray
4499858

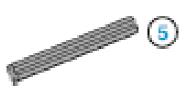
10x
Axle, 2-module, red
4142865



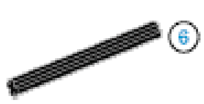
14x
Axle, 3-module, gray
4211815



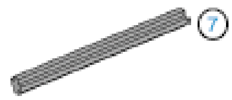
4x
Axle, 4-module, black
370526



6x
Axle, 5-module, gray
4211639

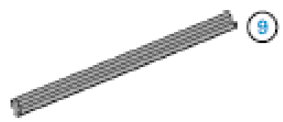


4x
Axle, 6-module, black
370626



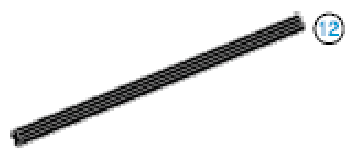
5x
Axle, 7-module, gray
4211805

2x
Axle, 8-module, black
370726

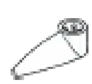


2x
Axle, 9-module, gray
4535768

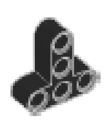
2x
Axle, 10-module, black
373726



2x
Axle, 12-module, black
370826



4x
Pointer, 3-module, white
4173941



4x
T-Beam, 3x3-module, black
4552347


4x
Beam with crosshole, 2-module, black
6006140


2x
Beam, 3-module, black
4142822

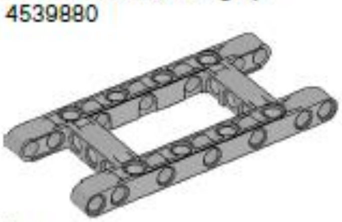

4x
Beam, 3-module, green
6007973


4x
Beam, 3-module, red
4153718

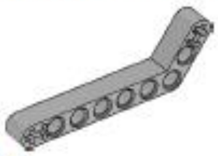

4x
Beam, 3-module, blue
4509376


4x
Beam, 3-module, yellow
4153707


3x
Frame, 5x7-module, gray
4539880


1x
Frame, 5x11-module, gray
4540797


6x
Angular beam, 4x4-module, white
4509912


4x
Angular beam, 3x7-module, gray
4211624


4x
Angular beam, 4x6-module, black
4112282


4x
Double angular beam, 3x7-module, white
4495412

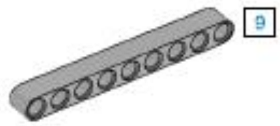

6x
Angular beam, 2x4-module, red
4141270


2x
Angular beam, 3x5-module, gray
4211713


4x
Angular beam, 3x5-module, white
4585040

4x
Beam, 5-module, gray
4211651

4x
Beam, 7-module, gray
4495930



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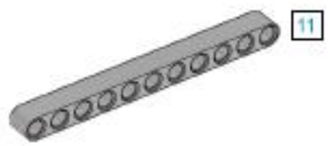
Beam, 9-module, gray
4211866



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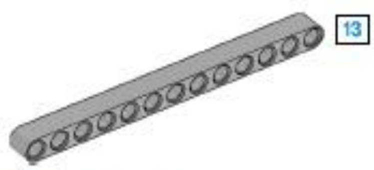
Beam, 11-module, gray
4611705



6x
Beam, 13-module, gray
4522934

6x
Beam, 15-module, white
4542578