READING ROBOTS

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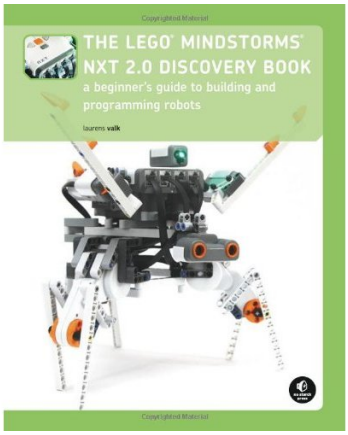

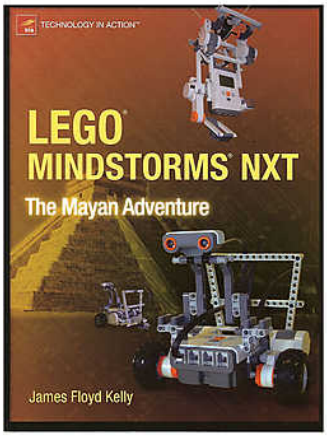

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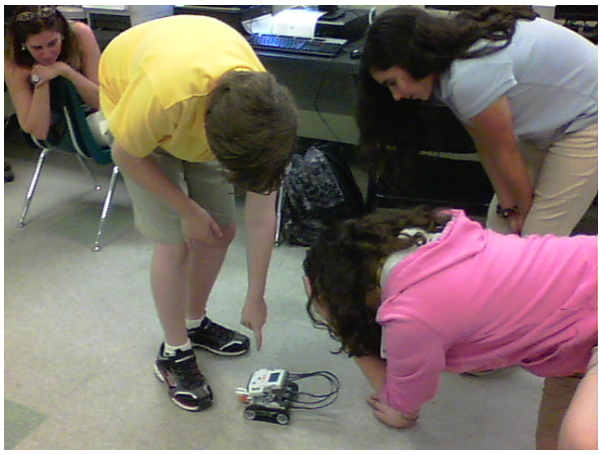


Goals and Objectives

Common Core Standards: (http://www.fldoe.org/educators/standards.asp)

English Language Arts – Reading Informational Text:

- RI.6.1. Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
- RI.6.4. Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings.
- RI.6.7. Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.

English Language Arts – Reading Literature:

- RL.6.1. Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
- RL.6.2. Determine a theme or central idea of a text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.
- RL.6.3. Describe how a particular story's or drama's plot unfolds in a series of episodes as well as how the characters respond or change as the plot moves toward a resolution.

Writing:

- W.6.2. Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
- W.6.3. Write narratives to develop real or imagined experiences or events using effective technique, relevant descriptive details, and well-structured event sequences.

Speaking and Listening:

- SL.6.1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.

NCTM Process Standards of: Problem Solving, Communication, Connections and Representations (http://www.nctm.org/standards/content.aspx?id=322)

1. **Problem Solving**
    a. Instructional programs from prekindergarten through grade 12 should enable all students to—
        - Build new mathematical knowledge through problem solving
        - Solve problems that arise in mathematics and in other contexts
        - Apply and adapt a variety of appropriate strategies to solve problems
        - Monitor and reflect on the process of mathematical problem solving
2. **Representation**
    a. Instructional programs from prekindergarten through grade 12 should enable all students to—
        - Create and use representations to organize, record, and communicate mathematical ideas
        - Select, apply, and translate among mathematical representations to solve problems

1. Use representations to model and interpret physical, social, and mathematical phenomena

FLDOE Robotics Curriculum Framework
(www.fldoe.org/workforce/dwdframe/1213/stem/rtf/9410100.rtf)

1. **09.0 Build, program, and configure a robot to perform predefined tasks. The student will be able to:**
    - Build a robot
    - Create programs using robotic software that will allow the robot to perform a set of tasks
    - Create a flow chart that visually describes a basic robotic task
    - Configure servo and motors to operate the robot
    - Create and present a proposal, including drawings and specifications, describing the robot, the tasks and rationale, and the results.
2. **10.0 Solve problems using critical thinking skills, creativity, and innovation. The student will be able to:**
    - Employ critical thinking skills independently and in teams to solve problems and make decisions
    - Employ critical thinking and interpersonal skills to resolve conflicts
    - Conduct technical research to gather information necessary for decision-making.

Overview

Using LEGO Mindstorms NXT 2.0 robotics kits and two books, *The LEGO Mindstorms NXT 2.0 Discovery Book: A Beginner's Guide to Building and Programming Robots* and *Technology in Action: LEGO Mindstorms NXT: The Mayan Adventure,* students learn programming, robot design, and increase their problem solving and creativity skills. Once they get through the basics in the Discovery book – helping their reading comprehension with non-fiction text, they go to the Mayan Adventure book. In the Mayan Adventure book, they read about an adventure of a boy and his uncle exploring a Mayan tomb of an ancient king. In this adventure, they have obstacles to overcome by building an exploration robot and programming it to get past the obstacles. This book is also a beginner guide to the NXT robots, but since it is in a story format it helps with reading comprehension as well.

Students work in cooperative teams of 3 to 4 students per kit. They have different roles – Team Leader (motivates and keeps the group moving along), Materials Procurer (gets the parts needed for the robot), and Builder/Programmer (puts the parts together and then sits at the computer to program the robot using advice from the other group members – if there are 4 students in the

group, this can be done by two different students). These roles will rotate for each of the different robots. Using the *Mayan Adventure* book, they will: read the story, use a design journal to plan a robot, test the robot, and make adjustments as needed. The book gives an option of a robot to be designed and programmed, but the students will try on their own first. As a culminating activity the groups will design an obstacle similar to the ones in the book for other groups to solve. They will write a short story, have their own diagrams and plans to solve the obstacle. They will test and make sure their plan works. Then each group will exchange their story and obstacle problem with other groups and attempt to solve each other's obstacles.
Our school uses a block schedule which gives 80 minute periods each time we meet (about every other day – some weeks we meet three times and other weeks we meet twice). It took about two to three weeks to read about, plan, build and program each of the different robots we used to solve the obstacle problems in the stories.

Outline

The following is intended as an example. Alter as desired.

First Two Weeks:

Introduce robotics and different types of robots through brainstorming and videos from Discovery Education, (This is a program that our school district has for teachers to use. You can access it from the employee portal home page.). During this time, students will learn the basics of building and programming robots using *The LEGO Mindstorms NXT 2.0 Discovery Book: A Beginner's Guide to Building and Programming Robots.* Using Part 1: Getting Started and Part 2: Building and Programming Robots with Sensors should be sufficient for this.

Weeks Three Through Seventeen – Learn about and build five different robots to solve obstacle problems in the *Technology in Action: LEGO Mindstorms NXT: The Mayan Adventure* book (the book has stories and solutions for five different robots: ExploreBot, StringBot, SnapShotBot, GrabberBot, and PushBot).

For each robot you decide to have your students build (you may want to build all of the bots or only a few depending on the time available and ability level of students):

- Read the "story" in the book (every 3 chapters have a story/adventure along with diagrams and ideas from the point of view of the nephew of how to solve the problem).
- Read and understand diagrams given in the book.

- Use a design journal to plan by: giving a robot description, listing a task list of what the robot needs to do, understanding the limitations and constraints of their robot, drawing a diagram of what the robot will do (including measurements and directions the robot will travel), brainstorming questions, observations, and ideas, and sketching what the robot will look like and what parts should be used to build it.
- Once the students plan, they will build their robot. The first time, have them use the steps given in the book of a robot to build that can solve the problem of the obstacle. For each subsequent obstacle, the teams will first try to design, build and program robots to solve the problems without using the solution in the book – if needed, they may use the solutions depending on their ability level.
- After the robot is built, the teams will then program the robot to follow the steps of the tasks and directions to move in order to solve the problem of the obstacle in the story.

Weeks Eighteen through Twenty (Student Created Obstacles and Robots):

- Teams plan and create a short story similar to the ones in the book. There should be an obstacle problem and robot to challenge the other teams to solve.

Evaluation:

1. As formative evaluations throughout the project, I collected the students' design journals and made observations of their group work. I used rubrics to assign points and grades.
2. As a summative evaluation I also collected the design journals and made observations. I used a rubric to assign points and grades. The students and I created a student rubric for the teams to use to assess their classmates on how they solve the problems they created during the final project. *You could also assess vocabulary understanding and reading comprehension through teacher made tests. The students can help you create a word wall of vocabulary terms as well.

Sample Lesson Plan for introduction (Alter as desired):

GOALS AND OBJECTIVES:

Students will:

RI.6.7. Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.

W.6.2. Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

SL.6.1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.

09.0 Build, program, and configure a robot to perform predefined tasks.

Other objectives:

- Build and express background knowledge of robots.
- Contribute to whole and small group discussion during brainstorming and after viewing a video.
- Write about what was learned in a journal.
- Explore robotics history
- Compare and contrast various applications of automation and robotics
- Describe emerging technologies and their implications on the field of robotics.

ACTIVITIES:

- Use Inspiration software and the interactive whiteboard to have a class discussion and brainstorming session to create a web diagram of everything the students know or think about robots. (If you do not have Inspiration or similar application, you could use chart paper so that the web diagram can be saved and revisited).
- Watch and discuss the video from Discovery Education entitled "Dean of Invention: Robot Revolution" which shows three recent robot inventions and their uses to help society. Add to the Inspiration robot web with new information learned from video. This web will be regularly re-visited throughout the project.
- Divide students into small cooperative groups of no more than 4 – 5 students.
- Assign and discuss the group roles of leader, materials, builder and programmer.
- Have students begin a design journal with date and explanation of the day's activities using the following prompts (if your class has access to computers, it could be digital):
    - What did we do?
    - What was most interesting to you?
    - What did you learn?
    - What are the different group roles and what does each role do?
    - What do you hope to learn in the future during the project?
- Revisit and make changes/add to the web diagram.

EVALUATION:

The teacher will use a collaboration rubric and a journal response rubric to analyze and evaluate the students' journals and discussions. *I went to a few sites to find free, readymade rubrics that I could alter if needed.

http://www.bie.org/tools/freebies/cat/rubrics (I used the "collaboration rubric" from here without many changes)

http://www.rubrics4teachers.com/ (I used the "journal response and comprehension rubric" from here, also without many changes).

http://www.teach-nology.com/web_tools/rubrics/

http://www.rcampus.com/rubricshellc.cfm?mode=gallery&sms=publicrub& (this site has MANY rubrics and you can edit them online too).

After the introductory lesson, we moved into the basics of building and programming the robots. The first part in *The LEGO Mindstorms NXT 2.0 Discovery Book: A Beginner's Guide to Building and Programming Robots* is called Part I: Getting Started. For more control of the parts in the kit, I did the first chapter, *Collecting the equipment for your robot,* myself. I also took out the parts needed for the explorer bot that will be built and put them in large zip-lock bags for each group. As a class, we moved on to the second chapter called *Building your first robot.* A sample lesson for this chapter follows on the next page.

I also found a site that had free fun projects that have building instructions and the programs all ready to download into the brick. I used the one called the "five minute bot". I did not build that actual bot, but I downloaded the program into the brick of the design we would build. I then did a quick demo of the programming and making the robot move – this really motivated the students for the entire project, plus, if teams were advanced, they could go to this site and try out the different robots there while other groups were working on the robot of the lesson for the day(s). The site is called nxtprograms.com and the link to the site for the NXT 2.0 software programs is http://nxtprograms.com/index2.html.

Sample lesson for *The LEGO Mindstorms NXT 2.0 Discovery Book: A Beginner's Guide to Building and Programming Robots Chapter 2* (Alter as desired)

Goals and Objectives:

Students will:

RI.6.7. Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.

W.6.2. Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

SL.6.1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.

09.0 Build, program, and configure a robot to perform predefined tasks.

NCTM Process Standards, Representation:

- Use representations to model and interpret physical, social, and mathematical phenomena.

Activities:

- As a whole class, students and teacher go through the chapter using SQR3 Method of Reading in order to increase comprehension of the non-fiction text. In the first few chapters, we did this as a whole class in order to model the behavior, after that, the students did this in their groups with teacher observation and guidance.

  The SQR3 Method of Reading

  - **Survey the chapter.**
    Read the introduction to the chapter.
    - Look over the major section headings. Glance at the figures, diagrams and illustrations.
    - Skim questions, key words and summaries at the end of the chapter.
    - Create a context for remembering information.
    - Generate interest and a sense of what is important.
  - **Question. Create and answer questions.**
    For each section in the chapter, ask these 4 basic questions (write them in your journal and save space for possible answers):
    1. What is the main point?
    2. What evidence supports the main point?
    3. What are the applications or examples?
    4. How is this related to the rest of the chapter, the book, the world, to me?

- **Read the section**.
  - Skim or read the section actively. Search for the answers to your questions.
  - Make notes in your journal to create your own organization.
    - Include:
      - Headings and subheadings
      - Keywords and definitions given in text
      - Answers to questions
    - Summarize main points
    - Write author's ideas in your own words
- **Recite the main points.**
  - Look up from the book and verbalize the answers to your questions.
  - Talk out loud and listen to the answers.
  - Recite (to class, group, partner and/or self) to remember
- **Review.**
  - Now go back and note the main points in the section.
  - Go back over the questions and see if you can still answer them. If not, refresh your memory and continue.
  - Add more notes in your journal.

- Once the SQR3 is done, move into groups and begin building the explore robot, following the charts and diagrams to choose parts and assemble them. The students should begin using their group roles of Manager, Materials Procurer, and Builder/Programmer. Help students see the relationship of the holes in the parts and the size. As the groups work, walk around and provide guidance as needed.
  - During this time students will build the robot and connect the cables.
- Students will then learn to use the NXT buttons to navigate on the NXT brick. There are diagrams and explanations to help students to understand how to do this.
- Have students continue their design journal with date and explanation of the day's activities using the following prompts (allow the members of the groups to discuss and help each other):
  - What did we do?
  - What was most interesting to you?
  - What did you learn?
  - What are the different group roles and what did each role do?
  - What do you hope to learn in the future during the project?
- Revisit and make changes/add to the web diagram as appropriate and if needed.

EVALUATION:

The teacher will use the collaboration rubric and journal response rubric to analyze and evaluate the students' journals and discussions.

The next chapter we moved on to was the third chapter, *Creating and modifying programs.* I demonstrated how to do the programming on the Smart Board. If you do not have an interactive white board here are some alternatives: 1) you could move from group to group demonstrating the software and steps while other groups are doing the SQR3 and/or 2) you could train one group and they can help you train other groups about the software and steps.

Sample lesson for *The LEGO Mindstorms NXT 2.0 Discovery Book: A Beginner's Guide to Building and Programming Robots Chapter 3* (Alter as desired)

Goals and Objectives:

Students will:

RI.6.7. Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.

W.6.2. Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

SL.6.1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.

09.0 Build, program, and configure a robot to perform predefined tasks.

Activities:

- As a whole class (or in groups, depending on ability), students and teacher go through the chapter using SQR3 Method of Reading in order to increase comprehension of the non-fiction text.
- Explore the NXT-G programming software and interface using the Smart Board and books.
- Demonstrate how to create a basic program and download it into the NXT brick.
- In their groups, students go and create the program, download it and run it with their robots. Continue the group roles (The students should keep the same roles as in the previous lesson, they will begin rotating with other lessons so that each can be a Manager, Materials Procurer, and Builder/Programmer. If they can handle it, allow students to take turns as the Programmer). As the groups work, walk around and provide guidance as needed.
- Have students continue their design journal with date and explanation of the day's activities using the following prompts (allow the members of the groups to discuss and help each other):
    - What did we do?
    - What was most interesting to you?

- What did you learn?
- What are the different group roles and what did each role do?
- What do you hope to learn in the future during the project?

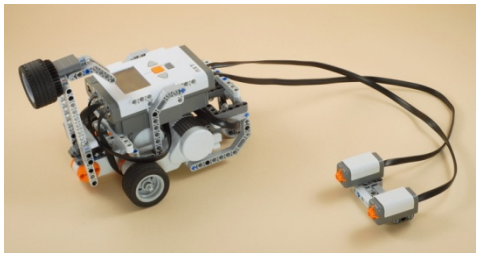
- Revisit and make changes/add to the web diagram if appropriate and as needed.

EVALUATION:

The teacher will use the collaboration rubric and journal response rubric to analyze and evaluate the students' journals and discussions.

After these first chapters, we continued with Part I to discover the use of the different programming blocks that tell the robot what to do. The lessons follow the format of the previous lessons for chapters 2 and 3. Students rotated roles for the different activities in the sections. In addition, these other Part I chapters contain challenges called "discoveries". The difficulty levels are listed with each discovery challenge. I performed the discoveries myself (as well as what each section demonstrated for the groups to perform) before I had the students try them so that I could give solutions in case the groups hit a snag and just couldn't solve them. For the journal, I added the questions: Which Discovery Activities did you do? What were the problems to solve? What steps solved the problem?

Once we finished Part I, we continued on to Part II: Building and Programming robots with sensors. In chapters 6 and 7, the author explains about the sensors in general, and then how to use the individual sensors. The lessons still followed the same formats and roles rotated. In chapters 8 and 9, the students would build two different robots that use the sensors. Since we woul be building different sorts of robots using the *Technology in Action: LEGO Mindstorms NXT: The Mayan Adventure* book, I skipped these chapters in order to save time. The rest of the beginner's guide is more advanced and I did not do these parts. If you feel you have time, then you can use the chapters I skipped.



The next step was to start using the *Technology in Action: LEGO Mindstorms NXT: The Mayan Adventure* book. In this book, the students can learn to build and program five robots. The author divided the book into five sections and each section into four chapters which include the fictional storyline, the planning and design, the building of the robot, and the programming and testing of the robot to solve the obstacle problem in the storyline. You could have the teams build and program all five of the robots, or pick and choose among them. If they complete at least two of the robots, they should be able to do the culminating activity of creating their own part of the storyline and designing a robot to be used in the storyline. A sample lesson plan of a section follows. Each section can use the same lesson plan format.

Sample lesson plan for the *Technology in Action: LEGO Mindstorms NXT: The Mayan Adventure* Chapters 1 - 4 (Alter as desired)

Goals and Objectives:

Students will:

RI.6.7. Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.

W.6.2. Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

SL.6.1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.

09.0 Build, program, and configure a robot to perform predefined tasks.

10.0 Solve problems using critical thinking skills, creativity, and innovation.

NCTM Process Standards of: Problem Solving and Representations

- Build new mathematical knowledge through problem solving
- Solve problems that arise in mathematics and in other contexts
- Apply and adapt a variety of appropriate strategies to solve problems
- Monitor and reflect on the process of mathematical problem solving
- Create and use representations to organize, record, and communicate mathematical ideas
- Select, apply, and translate among mathematical representations to solve problems

Activities:

- As a whole class (or in groups, depending on ability), students and teacher go through the chapter using SQR3 Method of Reading in order to increase comprehension of the non-fiction and fiction text (analyze the plot, setting, and characters).

- The students review and assume their roles in the project.
- Before moving to the non-fiction part of the text, students should use the design journal (Either create the format in their own journals, or make enlarged copies of the one provided by the author at the back of the book. I had the students use their own journals, but they used the headings on the design journal given by the author).
    - Sections of the journal are:
        - Robot Name (given by the author)
        - Robot Description (describe how they think the robot might look, what parts will be used, and what it needs to do in general.
        - Task List (list the tasks or steps the robot must do to solve the problem)
        - Limitations/Constraints (such as number of parts available, size and weight, weather and lighting conditions, floor or surface conditions, and movement requirements. There may be some constraints the will not be encountered until the building and programming begins. The main goal is to write down any limitations that come to mind.
        - Mindstorm (this is a brainstorming session where the students record questions, observations, and ideas that have been popping in their head since they learned about the challenge.
        - Sketches (draw simple sketches of how the robot might look from top and sides, along with directions and sensors that may need to be used.
- Next the students can move to the planning and design chapter to see the solutions and notes the author made and compare their notes with his and make changes IF they like.
- The next chapter is the building of the robot – the author gives step-by-step written and pictorial directions of how he would build the robot. The students can use his design if they like.
- After the students build the robot, then they can move on to the programming chapter and see how the author programmed his robot to solve the problem. They can use his information, program the robot using his step-by-step directions, test the robot to see if it does what it is supposed to do and adjust it as needed (the author writes about how he tested and adjusted his robot so the students can see the thinking process).
- Walk around the room guiding students as needed and observing and praising their successes.
- Have students continue their design journal with date and explanation of the day's activities using the following prompts (allow the members of the groups to discuss and help each other):
    - What did we do?
    - What was most interesting to you?
    - What did you learn?
    - What are the different group roles and what did each role do?
    - What do you hope to learn in the future during the project?
- Revisit and make changes/add to the web diagram as needed and if appropriate.

EVALUATION:

- The teacher will use the collaboration rubric and journal response rubric to analyze and evaluate the students' journals and discussions.

Once the teams have gone through the above process for all of the robots in the *Technology in Action: LEGO Mindstorms NXT: The Mayan Adventure* book (or as many as you want to complete, but I suggest at least two), we move on to the culminating activity. The students will use the *Technology in Action: LEGO Mindstorms NXT: The Mayan Adventure* book format as a model to how they will create their own storyline, planning and designing, building and programming sections. The storyline should follow the writing process to create. The other parts do not have to be as elaborate or long as the author have them in the book, the students just need to go through planning and designing their own robot, then building and programming it, and then testing it. They will trade the storylines with other groups and try to solve one another's problem obstacles. The teacher will walk around and guide as needed. Teams can consult one another for help in solving each other's problem obstacles.

Sample lesson plan for culminating activity (Alter as desired)

Goals and Objectives:

The student will:

- RI.6.1. Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
- RI.6.4. Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings.
- RI.6.7. Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.

- RL.6.2. Determine a theme or central idea of a text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.
- RL.6.3. Describe how a particular story's or drama's plot unfolds in a series of episodes as well as how the characters respond or change as the plot moves toward a resolution.

- W.6.2. Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
- W.6.3. Write narratives to develop real or imagined experiences or events using effective technique, relevant descriptive details, and well-structured event sequences.

- SL.6.1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.

09.0 Build, program, and configure a robot to perform predefined tasks.

10.0 Solve problems using critical thinking skills, creativity, and innovation.

NCTM Process Standards of: Problem Solving and Representations

- Build new mathematical knowledge through problem solving
- Solve problems that arise in mathematics and in other contexts
- Apply and adapt a variety of appropriate strategies to solve problems
- Monitor and reflect on the process of mathematical problem solving
- Create and use representations to organize, record, and communicate mathematical ideas
- Select, apply, and translate among mathematical representations to solve problems

Activities:

- In cooperative groups, students will use the writing process to create their own fictional storyline using the *Technology in Action: LEGO Mindstorms NXT: The Mayan Adventure* book as a model.
- Teams will go through the planning and design, build it, and program it steps to create a robot to solve the problem obstacle in their storyline.
- Teams will exchange storylines with other teams and go through the planning and design, build it, and program it steps to create a robot to solve the problem obstacle in the storyline they received from other teams.
- Teams will consult with each other as needed to help them solve the problem obstacles.
- Walk around the room guiding students as needed and observing and praising their successes.
- Have students continue their design journal with date and explanation of the day's activities using the following prompts (allow the members of the groups to discuss and help each other):
    - What did we do?
    - What was most interesting to you?
    - What did you learn?
    - What are the different group roles and what did each role do?
    - What would you do differently in the future?
- Revisit and make changes/add to the web diagram as needed and if appropriate.

EVALUATION:

- Teams use the student/teacher made rubric to evaluate each other.
- The teacher will use the collaboration rubric and journal response rubric to analyze and evaluate the students' journals and discussions.



Resources

For my project, I used the following materials and resources. Depending on the funding received, you may have to alter the amounts.

1. 3 LEGO Mindstorms NXT 2.0 Kits (when I ordered these, the best price I found was from Amazon.com. Now the pricing may be different. You might also consider going to http://www.legoeducation.us/ and getting education kits from there).

2. *The LEGO Mindstorms NXT 2.0 Discovery Book: a beginner's guide to building and programming robots - one* per 1 – 2 Students depending on the funds available (I ordered 3 from Amazon.com)

3. *Technology in Action: LEGO Mindstorms NXT: The Mayan Adventure* - one per 1 – 2 Students (I ordered 3 from Amazon.com)

4. Lockable closet/containers to keep all the robotics parts.

5. 6 AA batteries per robot or rechargeable batteries that are ordered separately from the kit.

6. Computers for downloading software (comes with kit) and to use in programming the robots – 1 per group

7. A large area to build and test the robots

8. The project begins with a brainstorming session about robots and then a video from Discovery Education (on the teacher portal) called: *Dean of Invention: Robot Revolution.*

9. Other helpful books and websites:

10. *Mindstorms Made Easy by Karl B. Peterson*
11. *LEGO Mindstorms NXT 2.0 for Teens*
12. *Classroom Activities for the Busy Teacher: NXT (2nd Ed) by Dr Damien Kee*
13. *Getting Started with LEGO Robotics: A Guide for K-12 Educators by Mark Gura*
14. *http://mindstorms.lego.com/en-us/Default.aspx*
15. *http://nxtprograms.com/index2.html*
16. http://www.bie.org/tools/freebies/cat/rubrics
17. http://www.rubrics4teachers.com/
18. http://www.teach-nology.com/web_tools/rubrics/
19. http://www.rcampus.com/rubricshellc.cfm?mode=gallery&sms=publicrub&

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