Introduction to Lego Building

Lesson Objective: To familiarized the students with Lego vocabulary and specific building pieces.

Learning Objective: To learn the names and purposes of Lego building pieces

Materials:
Lego Simple Machine kits or other Lego building pieces
Engineer Checklist

Vocabulary
- bricks
- beams
- Lego separator

Procedure:

The lesson begins with a teacher lead discussion about engineering and Legos. The teacher may ask questions such as:
- Do you know anyone who is an engineer?
- What do you think an engineer does?
- Who has built with Legos before?
- What structures have you made?

Then, the students are presented with their first Lego challenge. Each student receives a checklist. They use the checklist with their partner to find the specified pieces from classroom bins or Simple Machines Lego kits. The students are instructed to find everything on their checklist, and then build a structure using the materials. Any structure is acceptable. The students are to draw a picture of their structure.

Next, the teacher encourages the students to share their structure with another pair. Following the sharing, the teacher leads the students in a wrap up discussion where the students discuss the following questions:
- Where do you see bricks, plates, and beams being used around you in your homes or school?
- How are the Lego pieces similar or different?
- How are the pieces organized?

The last question should lead into the final part of the lesson. Students will be instructed on how to properly care for, put away, and store Lego materials.

Extensions:

- Students can build the flattest or highest possible structure with the allotted pieces

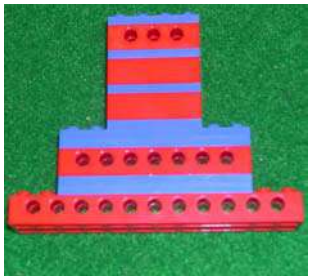
Assessment:

- complete checklist and draw a picture of structure
- name various pieces such as bricks, beams, or plates
- sort pieces into correct bins
- teacher observations and interviews

Trouble Shooting:

- some children will need help separating the small plates
- some students will be very familiar with vocabulary and building while for others this will be a new experience

Resources:
Lego/Tufts website- www.ceeo.tufts.edu/curriculum
Lego Dacta "Simple and Motorized Machines" Teacher Guide

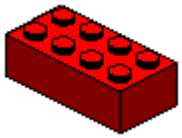


Engineer: _____ Date: _____

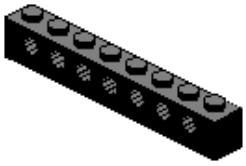
Partner: _____

Engineer's Checklist

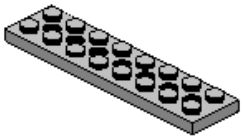
1. Collect the following pieces and place them on your tray.

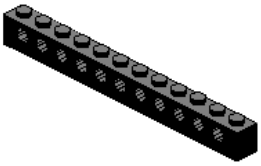
_____ two 2x4 bricks 

_____ two 1x4 beams 

_____ two 1x8 beams 

_____ four 2x4 plates 

_____ four 2x8 plates 

_____ two 1x12 beams 

_____ 1 separator 

2. Build a structure with your partners using the pieces on your checklist. Draw a picture of your structure.

Lesson Two: Building A Sturdy Car

Lesson Objective: To build a car (with a motor) that can withstand being dropped from the knee (of the teacher or student).

Learning Objectives: Building a sturdy car using a motor & a pulley

Materials:

lego building pieces
motors
pulleys
RCX

Vocabulary:

- motor
- pulley wheel
- belt
- RCX
- sturdy
- bushing

Procedure:

The lesson begins with a short discussion about what makes something sturdy when building with Legos. questions you might ask to guide the discussion could include:

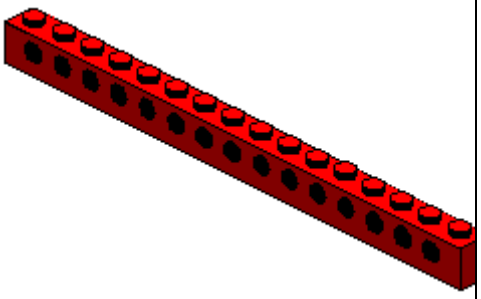
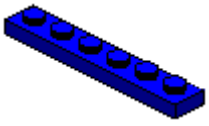
- What are some of the structures you build last year?
- What problems do you have if a structure is not sturdy?
- What did you do to make the structures strong?

After the discussion, introduce the challenge. Explain that the children will be working with a partner building a sturdy car. They may test their car as they build to see how sturdy it is. When finished, the car will be dropped from the teacher or student's knee and should not fall apart.

Steps to build a sturdy car:

STEP 1: Build a basic frame for the car

The frame of a car is made from:

	Tire	Wheels are made from tires and axel hubs
	Hub	Hubs are the center part of tires
	Bushing	Bushings keep
	Axle	Wheels are attached (using the hubs) to the axle
	Beam	Beams form the structure of the car and can support the photo
	Plates	Plates form a base for the motor

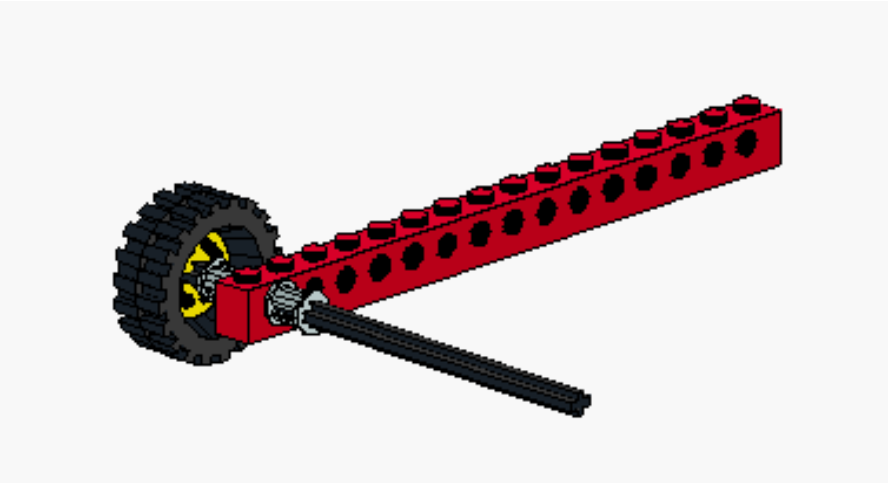


Figure 1: Partial Car Frame

Bushings are put on each side of the beam to keep the tires from sliding back and forth. They should be close to the beam but not TOO close. If they are too close the axle will not be able to turn (and hence the car will not be able to move).

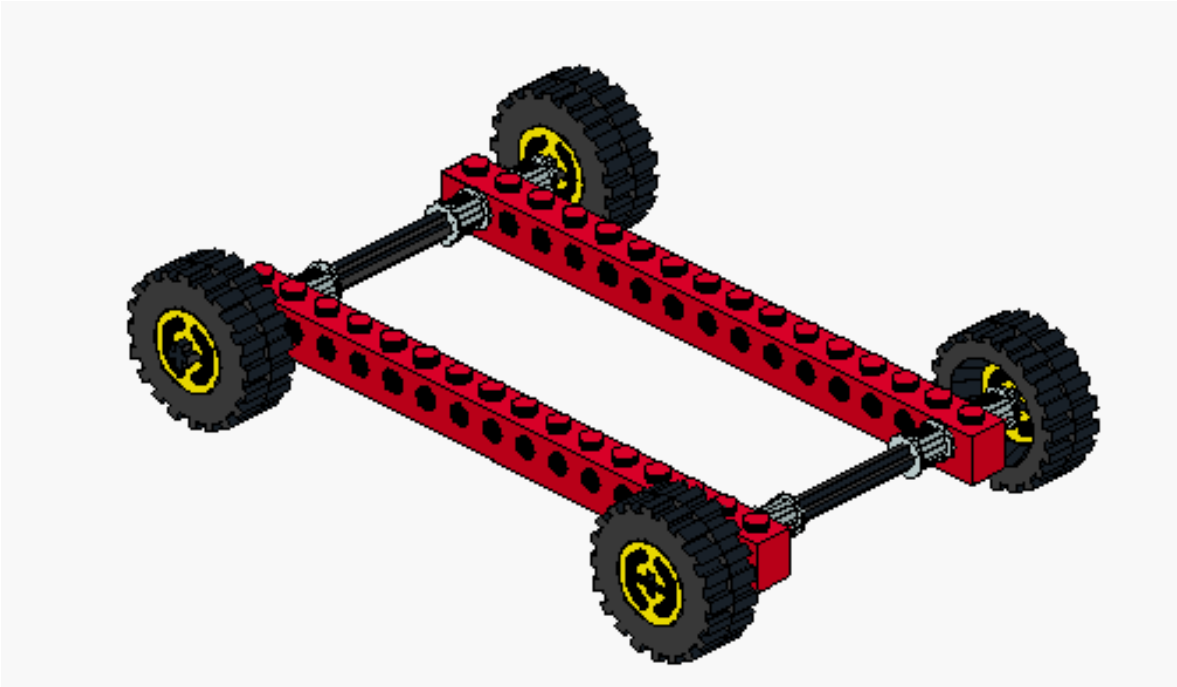


Figure 2: Sturdy Car Frame

It is important that the frame be as rectangular and symmetric as possible. If there is more friction on one side the car will tend turn in that direction.

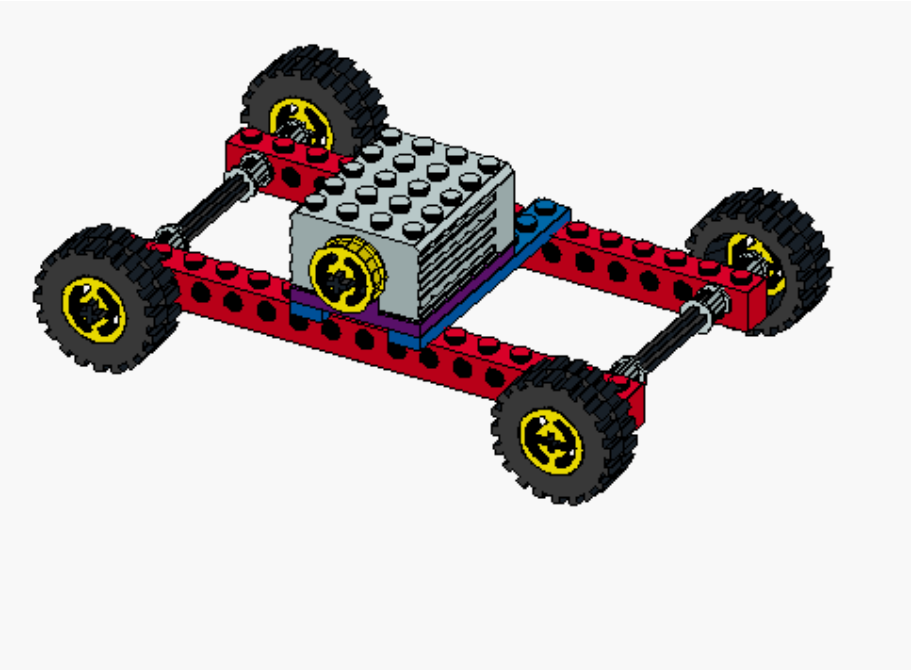


Figure 3: Add Motor to Car

You can attach the motor to the frame using flats.

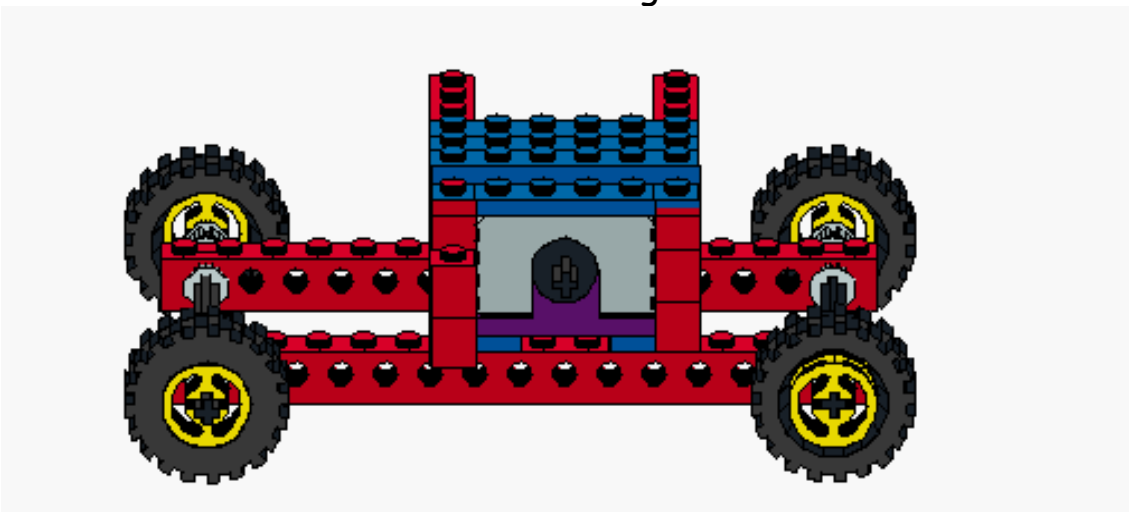


Figure 4: Car with Motor boxed in

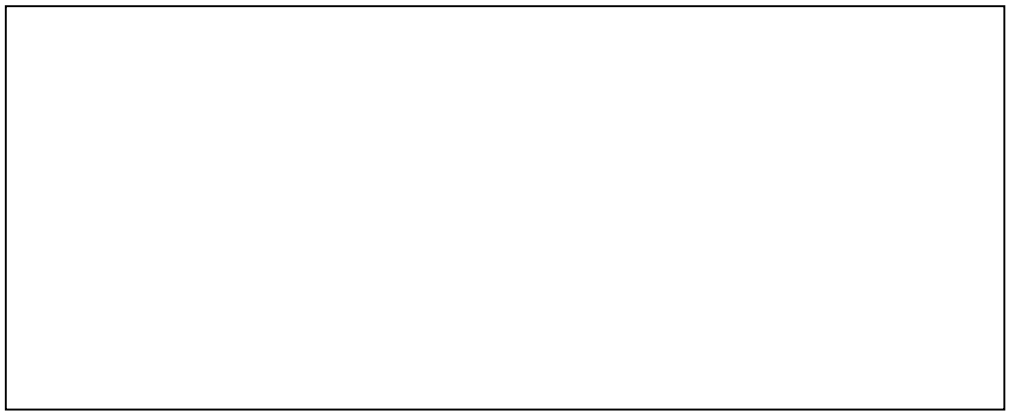
To keep the car from breaking when it is dropped from the knee you need to box the motor in on all sides so it's supported in all directions.

Engineer: _____ Date:_____
Partner: _____

Building Design Sheet: A Sturdy Car

Challenge: To build a car (with a motor) that can withstand being dropped from the knee (of the teacher or student).

- Draw your idea:



2. Write about your idea:

_____

_____

_____

_____

_____

_____

3. Now share your plans with a partner.

Lesson 3: Wheel & Axle

Lesson Objective: To build a tractor from Wilbur's barn that holds a miniature farm animal.

Learning Objectives: Building a sturdy structure using a motor & a pulley

Materials:

- Engineer's design sheet
- Lego building pieces
- motors
- pulleys

Robolab software

- RCX
- a miniature farm animal or stuffy

Vocabulary:

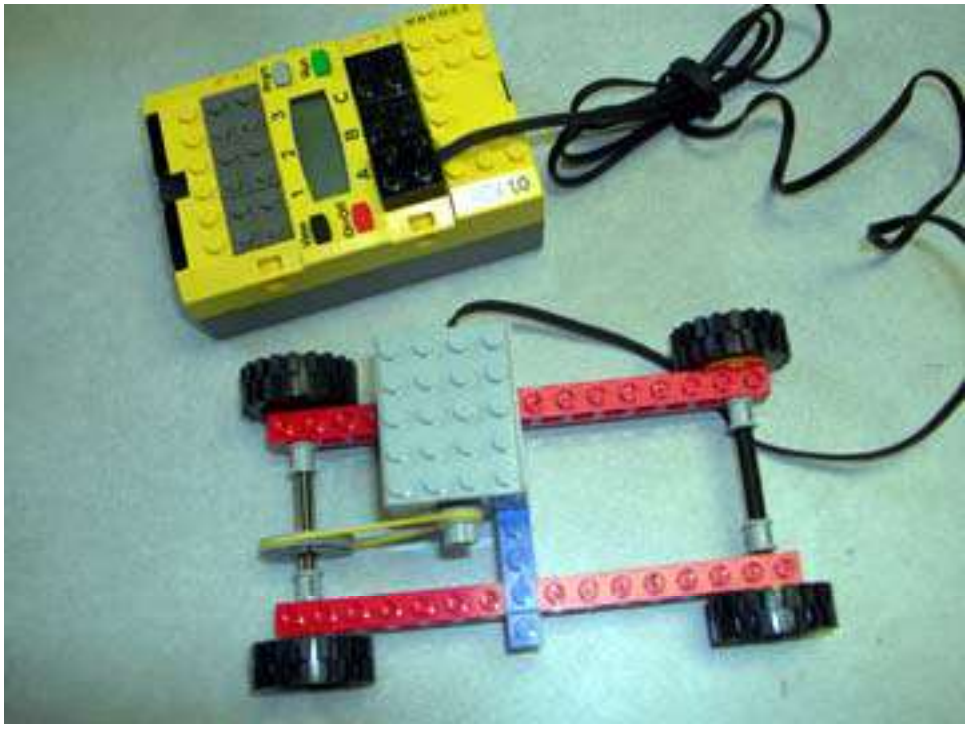
- Pulley
- Icon
- Motor

Procedure:

The lesson begins with a short discussion about *Charlotte's Web* and the barnyard. Direct the discussion to include the kinds of farm machines that might be in the barn. Questions you might ask could include:

- What are some of the farm machines you remember from your visit last spring to Codman Farm?
- Why does the farmer need to use these kind of machines?

Next, introduce the challenge- To build a tractor from Wilbur's barn that can hold a miniature farm animal or stuffy. Ask the children if they remember how to build a sturdy car. Review the key components of a sturdy car. Explain that they will be putting a motor and pulley on their tractor to be able to get it to move. The motor will be connected to the RCX for power. Show the children a model of the pulley system that they will be using on their tractor.



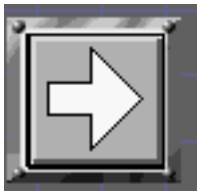
Distribute the student work sheet, "Building Design Sheet: A Tractor". First the children will draw their design. When they are finished they then need to write about their design. The children will then find a partner and share their design sheets with each other. They should talk about ways to use both people's ideas in their final building. Finally, the partners will build the tractor.

Programming:
Students will program their tractors in Pilot 1 or Inventor 1 to move forward for a set amount of time. Students should first plan out their program using the "Engineering Programming Sheet" and the "Programmer's Icon Sheet".

For Pilot:
After planning out their program on paper, the students should

- Click on the "Programmer" icon after opening up the software.
- They should then double click on "Pilot One".
- By holding down the icons with the mouse, the students can change the selection on the screen.
- They can choose different amounts of time (1,2,4,6,8 or 10 seconds).

- When they have finished selecting the program, the students can click on the arrow (see below) under the icons to download their program on the RCX. (Be sure the RCX is turned on).
- They should then test their program to see if it works.



- The students should repeat these steps two more times, changing the amount of time the tractor moves.

After successful completion of Pilot One programming, the students should then program in the "Pilot Three" program. Students should try programming their tractor to go forward and back for a selected amount of time.

Extensions:
Modify the tractor to tow something behind
Modify the tractor cab to give shade to the miniature farm animal
Assessment:

- Student journal (design sheet)
- completion of the challenge with teacher interview and observations
- successful programming of the tractor to move forward and back

Trouble Shooting:

- build a car with a motor and pulley to share with the children during the discussion of the challenge
- some children will be very familiar with building and other will have limited experience
- pulleys needs to be tight enough (but not too tight)
- some children will need help putting the pulley together

RCX Use Reminders:

- Use Program One to have the motor just run forward
- Attach the wire from the motor to port A (connect black to black)
- If the tractor is going the wrong direction, just turn the wire connected to the RCX half a circle (180°).
- If the children drop the RCX, or your change its batteries, it may loose its firmware (its "brains") & may not work properly.

- If the firmware is missing on the RCX, the four zeros will be missing on the readout of the RCX. It will not run properly. To download the firmware, go into the "administrator" and select "download firmware". (Be sure that the RCX is turned on & pointing at the tower.) Downloading firmware can take 3-4 minutes. When finished click on "Test RCX Communication" to check the firmware.

Resources:

book- Charlotte's Web by E.B. White
Lego Dacta "Simple and Motorized Machines" teacher guide

links to web sites
Tufts Engineering www.ceeo.tufts.edu/curriculum

Engineer: _____ Date: _____
Partner: _____

Building Design Sheet: A Tractor

Challenge: To build a tractor from Wilbur's barn that can hold a miniature farm animal.

- Draw your idea:

2. Write about your idea:

_____

_____

_____

_____

_____

_____

3. Now share your plans with a partner.

Engineer: _____ Date: _____
Partner: _____

Engineer's Programming Sheet

Your programming challenge is to move your tractor forward for 1, 2, 4, 6, 8, or 10 seconds. Use the icons on the Programmer's Icon Sheet to plan out your program.

Program 1: Our tractor will go forward for _____ seconds.

Program 2: Our tractor will go forward for _____ seconds.

Program 3: Our tractor will go forward for _____ seconds.

**Now, use *Pilot 3* to program your tractor to move *forward and backward*.

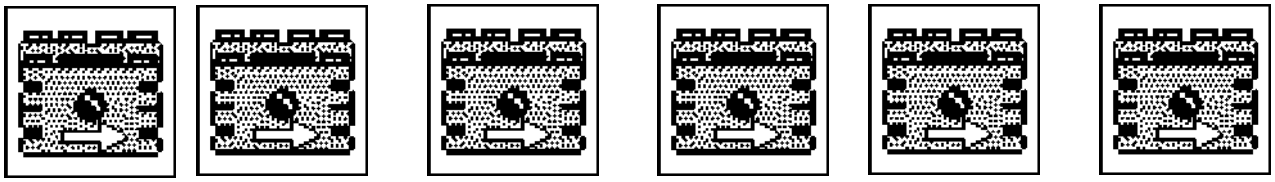
Program 4: Our tractor will go forward for _____ seconds. Our tractor will go backwards for _____ seconds.

Programmer's Icon Sheet

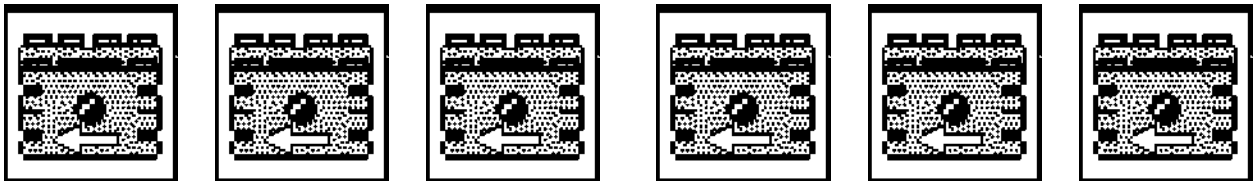
Cut and paste the icon desired on your "Engineering Programming Sheet"

Motors:

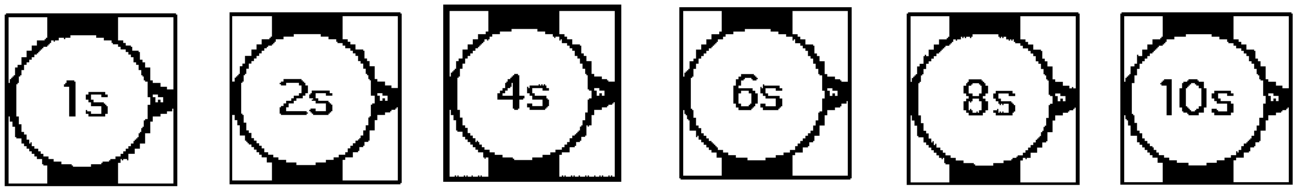
forward

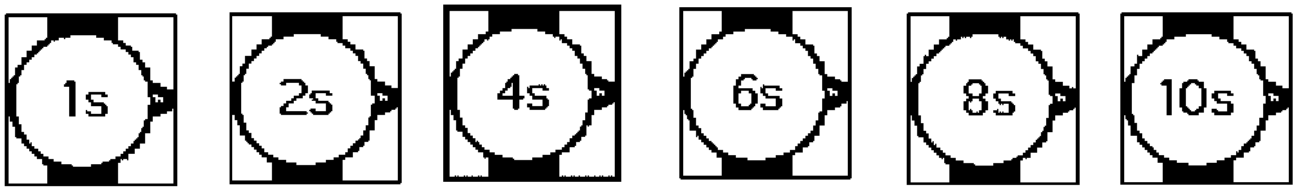


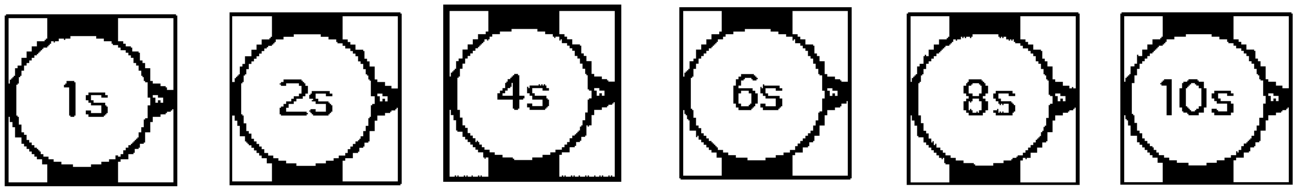
reverse



Time:







Lesson 4: Introduction to Pulleys

Lesson Objective: To familiarized the students with pulleys and build a simple pulley system

Learning Objective: To learn why pulleys are used and how the pulley wheels and belts work together to move an object

Materials:
Lego Simple Machine kits or other Lego building pieces
Building booklet "E",
Exploring with Pulleys Worksheet

Vocabulary:

- pulley wheel
- belt
- driver
- follower

Procedure:

The lesson begins with a teacher lead discussion about pulleys. The teacher should display different pictures of pulleys in action. The teacher may ask questions such as:

- Why do people use pulleys?
- How do pulleys work?
- How do you think you would build a pulley?

Next, the teacher shows the students a diagram of a pulley with the new vocabulary building words:

pulley wheel belt driver follower

Then, the students are presented with their Lego pulley challenge. Each student pair receives building booklet "E", a Simple Machines Lego kit, and an "Exploring with Pulleys" worksheet. They use the booklet and the kit with their partner to build the pulley step by step. The Pulley Worksheet is to be completed as they build and guide their thinking.

After building, the teacher leads the students in a wrap up discussion where the students discuss the following questions:

- How did you power your pulley?

- What direction did the pulleys move when the belt was flat (not crossed)? What direction did the pulleys move when the belt was crossed?
- What is something new that you learned about pulleys?

The final part of the lesson is when the students will be instructed on how to properly care for, put away, and store Lego materials.

Extensions:

- Students can motorize the pulley

Assessment:

- Build the pulley system from booklet "E"
- complete the "Exploring with Pulleys" Worksheet
- teacher observations and interviews

Trouble Shooting:

- some children will need help with the knots and winding the rope on to the pulley
- it is helpful to pair students with varying building experience together

Resources:
Lego/Tufts website- www.ceeo.tufts.edu/curriculum
Lego Dacta "Simple and Motorized Machines" Teacher Guide

Engineer: _____ Date: _____
Partner: _____

Exploring with Pulleys

Complete the engineering checklist. Follow each step carefully, and be sure to complete it before moving on to the next step.

_____ Build model E. 1

_____ Turn the black handle.

Do the two pulleys move in the same direction or different directions?

☐ same direction ☐ different direction

_____ Build model E. 2

_____ Turn the black handle.

Do the two pulleys move in the same direction or different directions?

☐ same direction ☐ different direction

_____ Label the pulleys below. A **driver** is the pulley with the handle. The pulley turned by the driver is called the **follower**. The driver is the boss telling the follower how to turn.

_____ _____

_____ Build model E. 3

_____ Turn the black handle.

Which pulley moves faster?

☐ driver ☐ follower

_____ Build model E. 4

_____ Turn the black handle.

Which pulley moves faster?

☐ driver ☐ follower

_____ Build model E. 5

____ Turn the black handle.
Which pulley moves faster?

☐ driver ☐ follower

____ Build model E. 6
____ Turn the black handle.
Which pulley moves faster?

☐ driver ☐ follower

____ Build model E. 7
____ Pull the string.

____ Build model E. 8
____ Pull the string.
How does this pulley work differently?

☐ easier to lift block ☐ harder to lift block

Pick one of the structures you built to draw below.

Lesson Five- Building a Crane using a Pulley System

Lesson Objective: To build to crane powered by a pulley system that can lift a simple load.

Learning Objective: To build a sturdy structure using Lego blocks & a pulley system.

Materials:

- Lego Dacta Simple Machine Set
- Lego Dacta Simple Machine blue building pamphlet #10 (part #9630)
- Lego building pieces

Vocabulary

- pulley wheel
- pulley rope or belt
- load
- driver
- follower

Procedure:

The lesson begins with a teacher lead discussion about pulleys. Review the names and parts of a pulley system. The teacher may ask questions such as:

- Has anyone used a pulley at home?
- What jobs are easier because of pulleys?
- Where have you seen pulleys in your community?
- What structures have pulleys in them?

Review "Lesson Four: Exploring with Pulleys". Then, present students with their Lego challenge. The students are instructed to draw a possible crane they could build out of Legos. Any structure is acceptable. Next, the teacher encourages the students to share their crane drawings with another student finding places where their designs are similar and where they are different. Following the sharing, the teacher directs the pair to build a crane

(they can use the Lego Dacta Simple Machine blue building pamphlet #10. **They should build up to Step 15 and then stop).** When completed, the students should use their crane to lift a load (such as Wilber the beanie baby, Lego people)

In the final part of the lesson, the student pairs share their crane model telling some of the successes and some of the problems they had in their building. Encourage the students to share how they solved their problems. Students will be instructed to save their models for the next lesson, "Lesson Six: Motorizing a Crane".

Extensions:

- Students can modify the crane to include some of the features they drew in their drawings
- Students add a cab to hold a worker
- Students build something to hold a load of pennies

Assessment:

- building a working model of a crane using a pulley system
- sort pieces into correct bins
- teacher observations and interviews

Trouble Shooting:

- following the building steps on the building pamphlet can be difficult for some learners
- In step 4 in the building pamphlet, tying the pulley rope will be difficult for most second graders. You might ask a parent or classroom aide to help set these up ahead of time.
- Step 9, #1 in the building pamphlet needs the end of the pulley rope to be knotted with a loop. You might ask a parent or classroom aide to help with this ahead of time.
- review how to size axles & pieces (Page 2 on the building pamphlet)

Resources:

Lego/Tufts website- www.ceeo.tufts.edu/curriculum
Lego Dacta "Simple and Motorized Machines" Teacher Guide
Lego Dacta Simple Machine blue building pamphlet #10 (#9630)

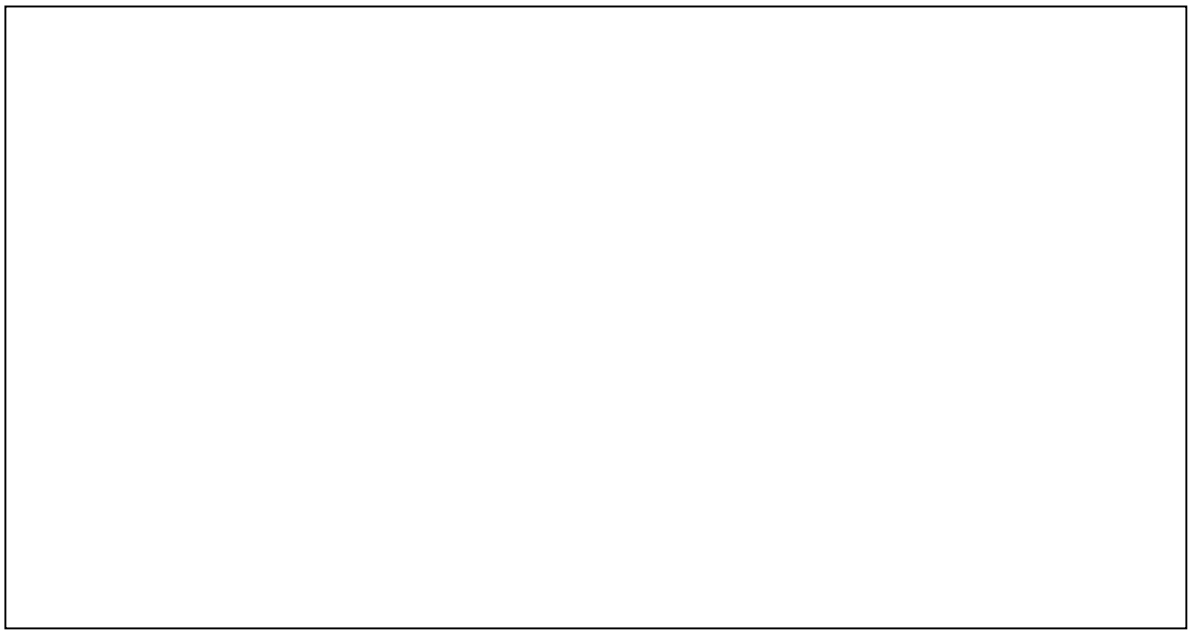
Engineer: _____ Date: _____

Partner: _____

Exploring with Pulleys

Challenge: To build a crane using a pulley system that can lift a simple load.

- Draw your idea:



2. Write about your idea:

_____

_____

_____

_____

_____

_____

_____

3. Now share your plans with a partner.

Lesson Six- Motorizing & Programming a Crane

Lesson Objective: To motorize a program a crane powered by a pulley system.

Learning Objective: To understand how a worm gear can slow down a pulley system to do more efficient work.

Materials:

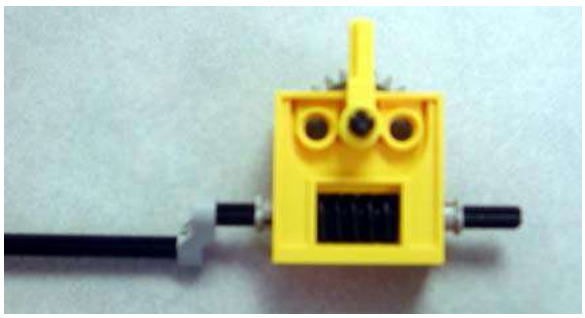
- Lego Dacta Simple Machine Set or necessary LEGO pieces
- Lego Dacta Simple Machine blue building pamphlet #10 (part #9630)- optional
- Extra axle extender
- RCX

Vocabulary

- RCX
- Worm Gear
- Rotation
- pulley wheel
- pulley rope or belt
- axle extender
- load
- driver
- follower

Procedure:

This lesson will begin with a brief introduction to the worm gear. The purpose of the worm gear is to "gear down" the crane, thus, slowing down the pulley that is essentially lifting the test objects. The teacher takes the worm gear from the kit and asks the students how it differs from the other gears in their kits. The teacher then adds a 24-tooth gear, two axles, a pointer, and a handle to the worm gear.



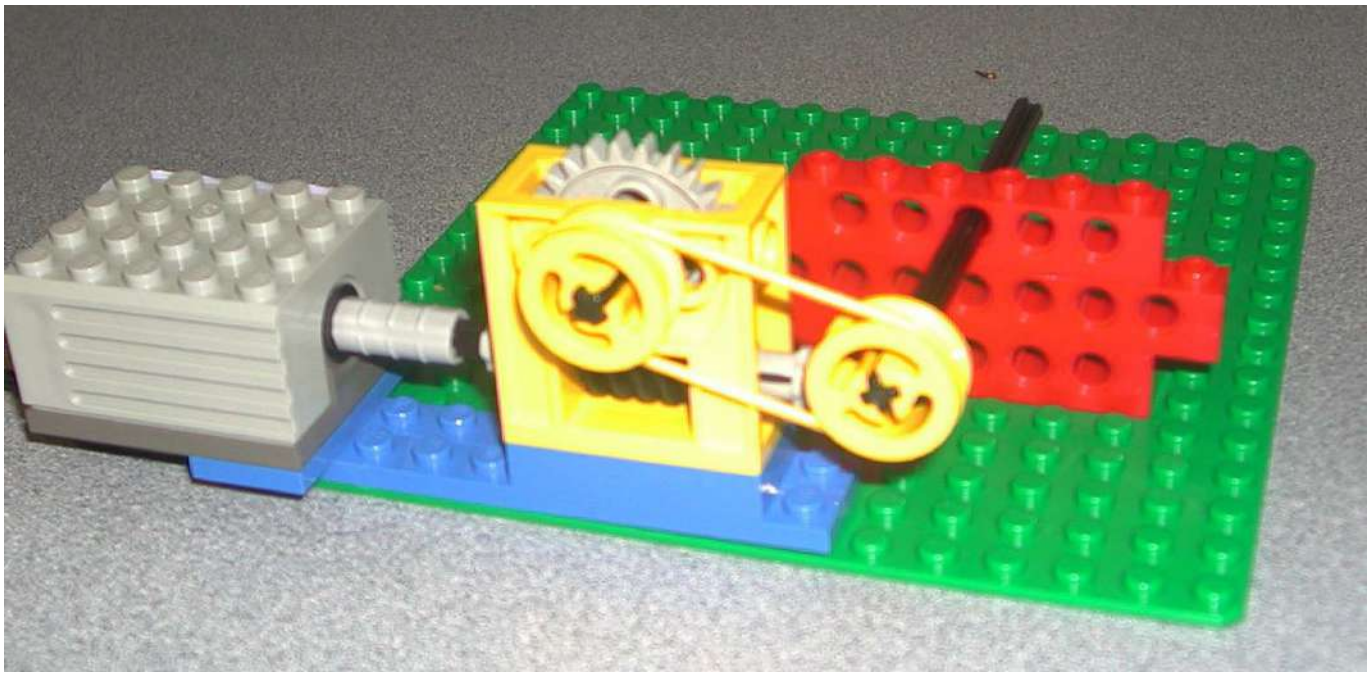
After assembling the pieces, the teacher asks the students to predict how many times they will have to turn the handle for the pointer to move from its starting position and back again. Their predictions should be recorded and students should be encouraged to share why they have made their prediction. Finally, it is time to turn the handle and count aloud the number of rotations. The handle should turn 24 times before the pointer returns to its original position.

Next introduce the challenge, to motorize the crane built in activity 96. Ask the children to share some of the key ideas about the worm gear that they discovered in their mini-lesson. Discuss why a worm gear might be useful in their crane. Ask how they might attach the worm gear to their crane.

The students are then instructed to think about the challenge and draw a possible solution on the response sheet. Distribute response sheet "Motorizing a Crane ". They then should write about their drawings and then share their ideas with their partner from Lesson Five. The partners should discuss ways to incorporate both ideas into their building plan. Finally, the pair should build their modified plan.

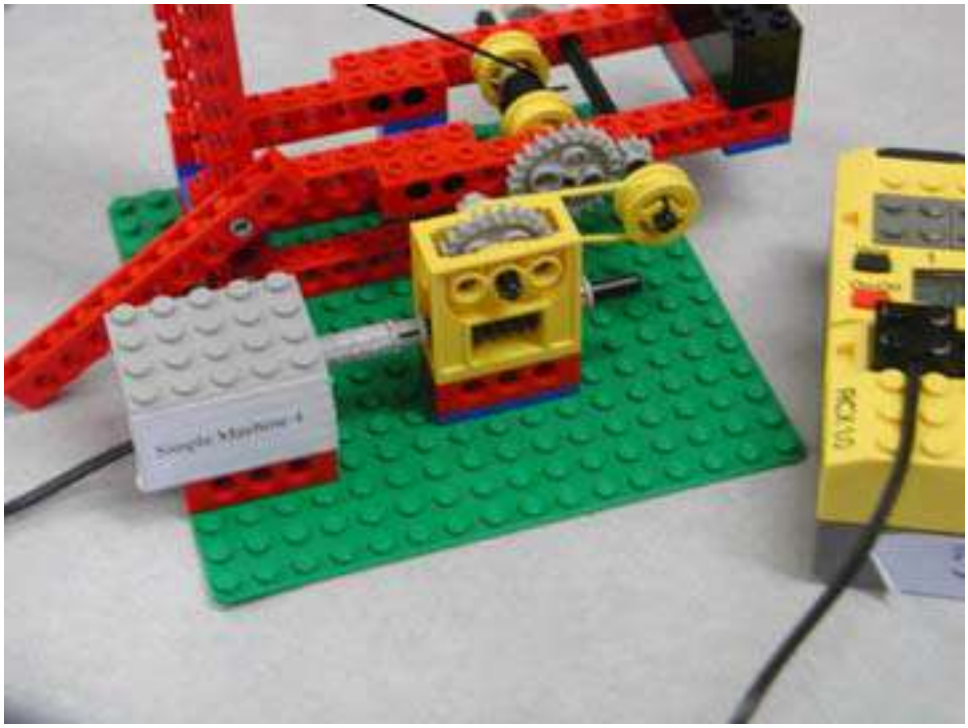
After the students have finished building and programming their crane, the student pairs should share their crane model telling some of the successes and some of the problems they had in their building and programming. Encourage the students to share how they solved their problems.

Here is one possible solution to adding the worm gear to motorizing the crane. The crane should be attached to the black axle on the right. Picture #17 in the Lego Dacta Simple Machine blue building pamphlet # 10 has another solution.



Programming:

Explain that they will program their cranes to pull up for a set amount of time and then to go down for the same amount of time. They will begin to program in Pilot 3 or Inventor 1. Students can first plan out their program using the "Engineering Programming Sheet" and the "Programmer's Icon Sheet". After planning out their program, then they can get on a computer and actually program and test the cranes.



Troubleshooting:

- Have the students start with the hook of the crane in the down position and the string on the crane rolled out as far as possible.
- Some students will need individual help using the computer.
- Remember to turn the RCX on & point it at the tower before clicking the download arrow.

Extensions:

- Students build something to hold a load of pennies
- Students can try to slow the motor down even more using different size pulleys

Assessment:

- successfully attaching a motor to the crane
- sort pieces into correct bins
- teacher observations and interviews

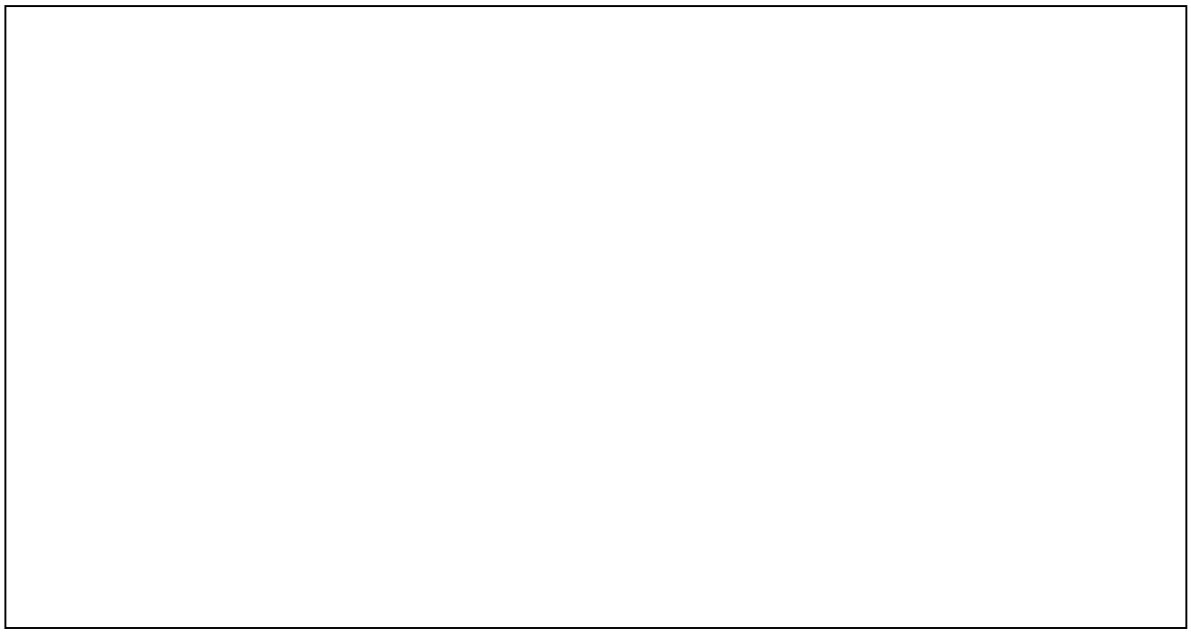
Engineer: _____ Date: _____

Partner: _____

Motorizing a Crane

Challenge: To add a motor to a crane and program the crane to lift a load.

- Draw your idea of how to put a motor on your crane (be sure to add your worm gear):



2. Write about your idea:

3.Now share your plans with a partner.

Engineer: _____ Date: _____

Partner: _____

Engineer's Programming Sheet

Your programming challenge is to lift a small test object to the top of your crane, and then safely lower back to the ground. Use the icons on the Programmer's Icon Sheet to plan out your program.

Program 1: Our crane will lift for _____ seconds. Our crane will lower for _____ seconds.

Program 2: Our crane will lift for _____ seconds. Our crane will lower for _____ seconds.

Program 3: Our crane will lift for _____ seconds. Our crane will lower for _____ seconds.

**Now, program your crane to use a touch sensor to stop and start.

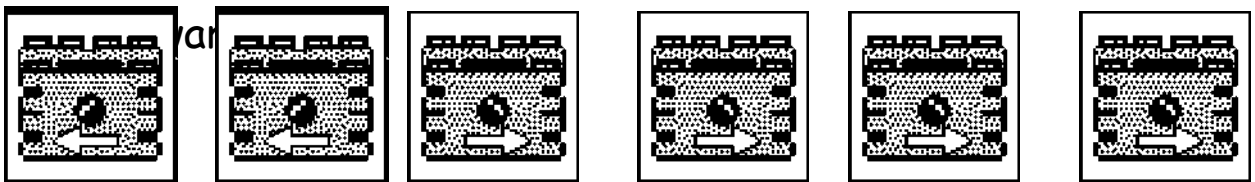
Program 4:

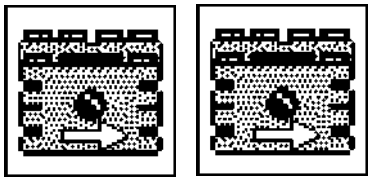
Program 5:

Programmer's Icon Sheet

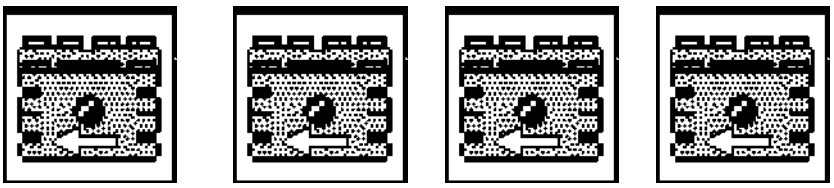
Cut and paste the icon desired on your "Engineering Programming Sheet"

Motors:

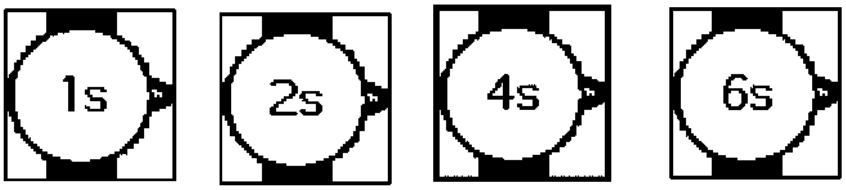


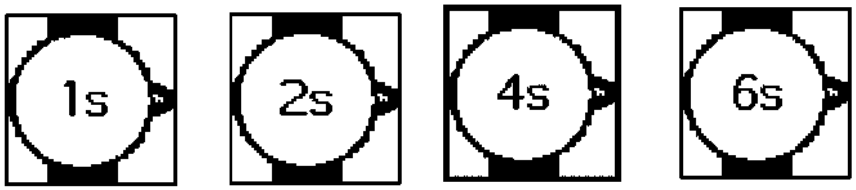


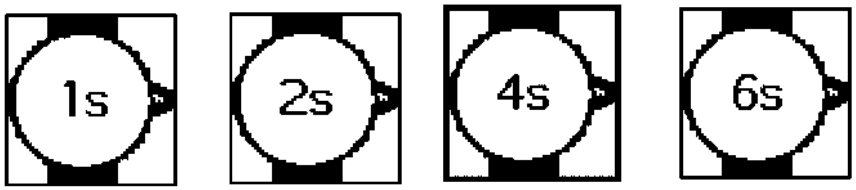
reverse



Time:







Touch Sensor:

Lesson Objective: To familiarized the students with levers and build a simple lever system such as a catapult.

Learning Objective: To learn why levers are used and how the lever can lift a load with little effort.

Materials:

- Lego Simple Machine kits or other Lego building pieces
- Building a Catapult
- Plastic spoon
- Cotton balls
- Masking tape

Vocabulary:

- load effort fulcrum

Procedure:

The lesson begins with a teacher lead discussion about levers. The teacher should display different pictures of pulleys in action. The teacher may ask questions such as:

- Why do people use levers?
- How do levers work?
- How do you think you would build a lever?

Next, the teacher shows the students a diagram of a lever with the new vocabulary building words:

load effort fulcrum

Then, the students are presented with their Lego lever challenge- to build a catapult that can throw a cotton ball 1 foot. The students are encouraged to design and draw their catapult on the "Building a Catapult" worksheet. The students should share their ideas with their partners. It might be helpful for a few students to share their ideas before moving on to the building stage.

Next, each student pair should receive a Simple Machines Lego kit or necessary pieces for the activity, plastic spoon, tape, cotton ball, and a "Building a Catapult" worksheet. It is time for building to begin.

When students have finished building their catapults, the teacher leads the students in a wrap up discussion where the students share their catapults, data, and discuss the following questions:

- What problems you had when building? How did you solve your problems?
- What difference did it make where the fulcrum was placed?
- What is something new that you learned about levers?

The final part of the lesson is when the students will be instructed on how to properly care for, put away, and store Lego materials.

Extensions:

- Students redesign catapult to throw further
- Students redesign catapult to throw more cotton balls

Assessment:

- Build a catapult that can throw a cotton ball 1 foot
- Complete the "Building a Catapult" Worksheet
- Teacher observations and interviews

Trouble Shooting:

- Plastic spoons break often
- Students will want to project heavier objects which is very dangerous
- Students will need to be reminder they are engineers and this is a serious project involving test and recording data

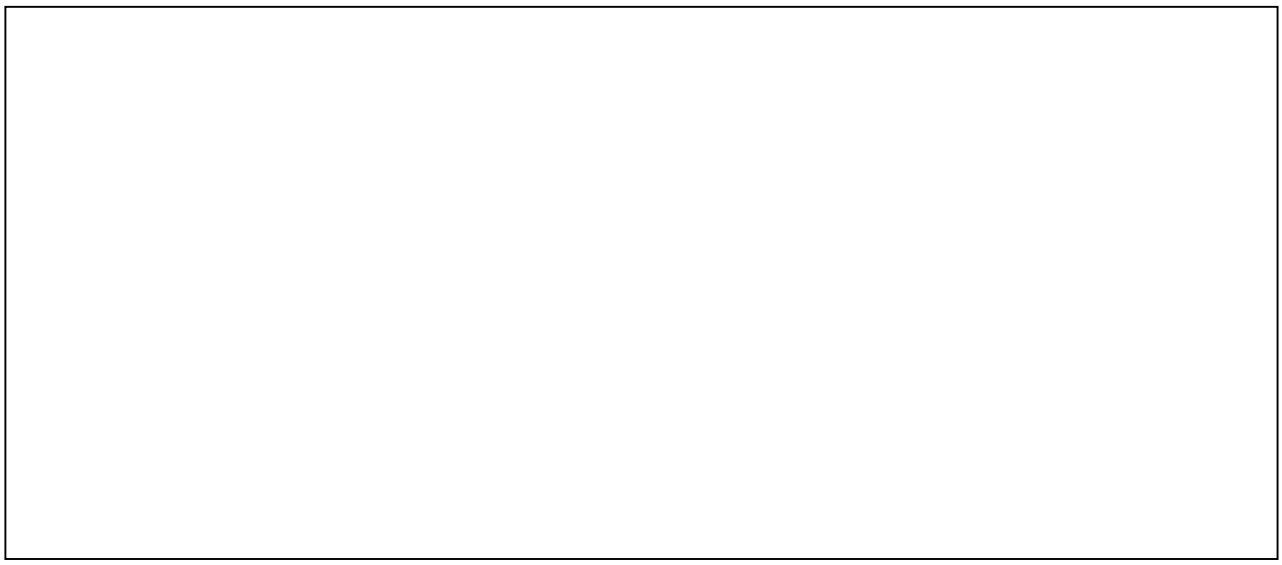
Resources:
Lego/Tufts website- www.ceeo.tufts.edu/curriculum
Lego Dacta "Simple and Motorized Machines" Teacher Guide

Engineer: _____ Date: _____
Partner: _____

Building a Catapult

Challenge: To build a catapult that can throw a cotton ball 1 foot.

1. Draw your idea.



2. Write about your idea.

3. Now share your plans with a partner.

Engineer: _____ Date: _____

Partner: _____

Building a Catapult

Challenge: To build a catapult that can throw a cotton ball 1 foot.

1. Using your idea and your partner's idea design a catapult. Draw your new design.

2. Build your design.

3. Test your design. Be sure to measure and record the distance your cotton ball travels. It is important to also write down changes you make to your design during testing.

Test #	Distance Cotton Ball Travels (Inches)	Changes Made to Design
1		
2		
3		
4		
5		

Lesson 8: Introduction to Gears

Lesson Objective: To familiarized the students with gears and build a simple gear system

Learning Objective: To learn why gears are used and how the gears work together.

Materials:
Lego Simple Machine kits or other Lego building pieces
Building booklet "D",
Exploring with Gears Worksheet

Vocabulary:

- gear
- teeth/tooth
- driver
- follower

Procedure:

The lesson begins with a teacher lead discussion about gears. The teacher should display different pictures of gears in action. The teacher may ask questions such as:

- Why do people use gears?
- How do gears work?
- Why do you think you would use gear in a building?

Next, the teacher shows the students a diagram of a gear system with the new vocabulary building words:

gear tooth/teeth driver follower

Then, the students are presented with their Lego gear challenge. Each student pair receives building booklet "D", a Simple Machines Lego kit, and an "Exploring with Gears" worksheet. They use the booklet and the kit with

their partner to build different gear models step by step. The Gear Worksheet is to be completed as they build and guide their thinking.

After building, the teacher leads the students in a wrap up discussion where the students discuss the following questions:

- What was your power source for turning the gears?
- Did the direction the follower gear turn depend on which way the driver gear turn?
- Have you seen any gears like the models you built?
- What is something new that you learned about gears?

The final part of the lesson is when the students will be instructed on how to properly care for, put away, and store Lego materials.

Extensions:

- Students can motorize the gear systems

Engineer: _____ Date: _____

Partner: _____

Exploring with Gears

Complete the engineering checklist. Follow each step carefully, and be sure to complete it before moving on to the next step.

_____ Build model D. 1

_____ Turn the gray handle.

Do the two gears turn in the same direction or different directions?

☐ same direction ☐ different direction

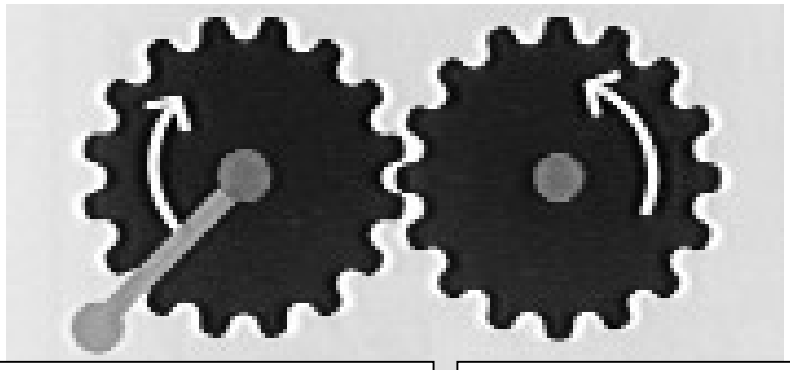
_____ Build model D. 2

_____ Turn the gray handle.

Do the two big gears move in the same direction or different directions?

☐ same direction ☐ different direction

_____ Label the gears below. A **driver** is the gear with the handle that you (or a motor) turns. The gear turned by the driver is called the **follower**. The driver is the boss telling the follower how to turn.



_____ Build model D. 3

_____ Turn the gray handle.

Which gear moves faster?

☐ driver ☐ follower

_____ Build model D. 4

_____ Turn the gray handle.

Which gear moves faster?

☐ driver ☐ follower

_____ Build model D. 5

_____ Turn the gray handle.

Draw a picture of your gear model. Draw an arrow to the gear that moves the fastest?

Extras

_____ Build model D. 6

_____ Turn the gray handle.

What is different about this gear model?

_____

_____

_____

_____ Build model D. 7

_____ Turn the gray handle.

Can you turn the handle in both directions? Why?

_____

_____

_____

Lesson 9- Building an optical illusion system

Lesson Objective: To build to a system, using gears, that will spin a piece of paper fast enough to create an optical illusion (a parrot in a cage)

Lesson Objective: Understand which combination/configuration of gears creates faster rotations.

Materials:

- Lego building pieces
- Parrot/Cage Printout (for cutting)
- Gears and Parrot Handout

Vocabulary

- Gear
- Tooth/Teeth
- Driver
- Follower

Procedure:

The lesson begins with a teacher lead discussion about gears. Review the names and parts of a gear system. The teacher may ask questions such as:

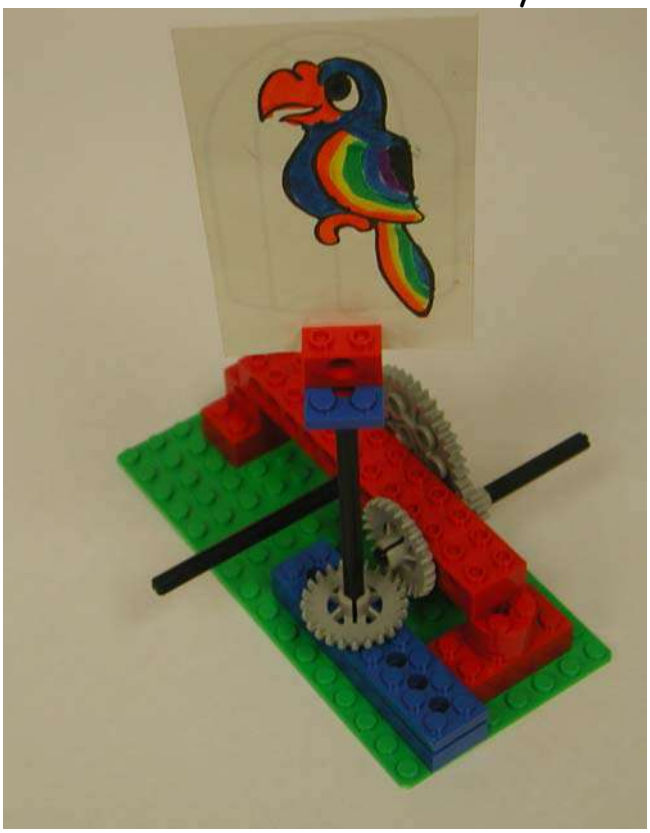
- Where have you seen gears at home?
- Where have you seen pulleys in your community?
- What toys have gears in them?

Review models D3, D5, & D6 that the children built from the "Lesson Eight: Exploring with Gears". Emphasize which combination of gears make the final gear rotate more. Discuss how more than one gear can be on a axle. Then, the students are presented with their Lego challenge. The students are instructed to draw a possible structure that could rotate a piece of paper (with a parrot on one side and a cage on the other). Any structure is acceptable. Next, the teacher encourages the students to share their paper rotator drawings with another student finding places where their designs are similar and where they are different.

Following the sharing, the teacher directs the pair to cut out the parrot and cage rectangles and glue them together. The groups should then build

their designs . When completed, the creation should be able to rotate the piece of paper fast enough so that it appears the parrot is in the cage

In the final part of the lesson, the student pairs share their models and tell some of the successes and some of the problems they had in their building. Encourage the students to share how they solved their problems.



Sample Set-up

Extensions:

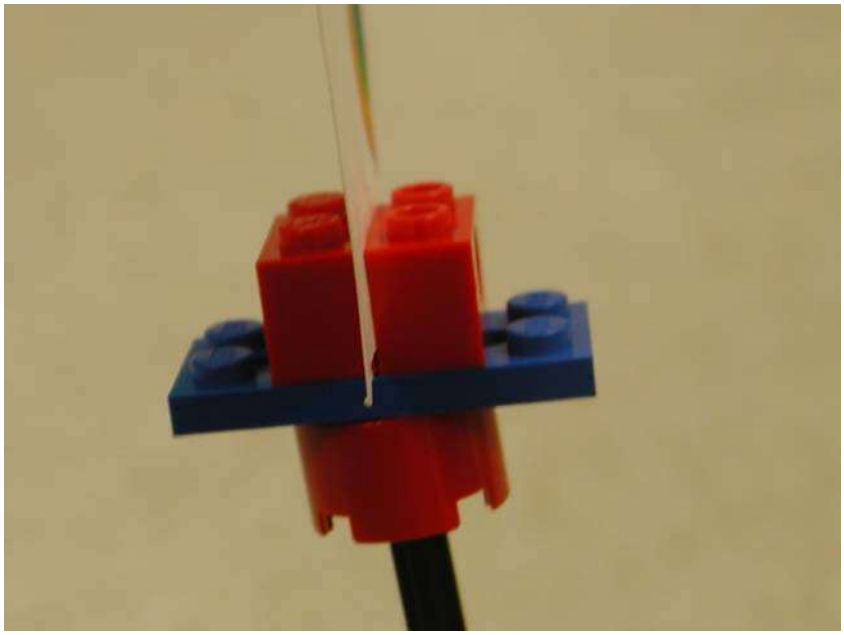
- Students can design and color their own creations
- Students can motorize their creation

Assessment:

- building a working paper rotation system
- explain why they choose the gears that they did
- sort pieces into correct bins
- teacher observations and interviews

Trouble Shooting:

- Students may have trouble creating a vertical rotation system (highlight D.6 from Lesson Eight)
- Some Students may have difficulty figuring out how to hold the paper tightly



- Sandwich the parrot/cage paper between two blocks

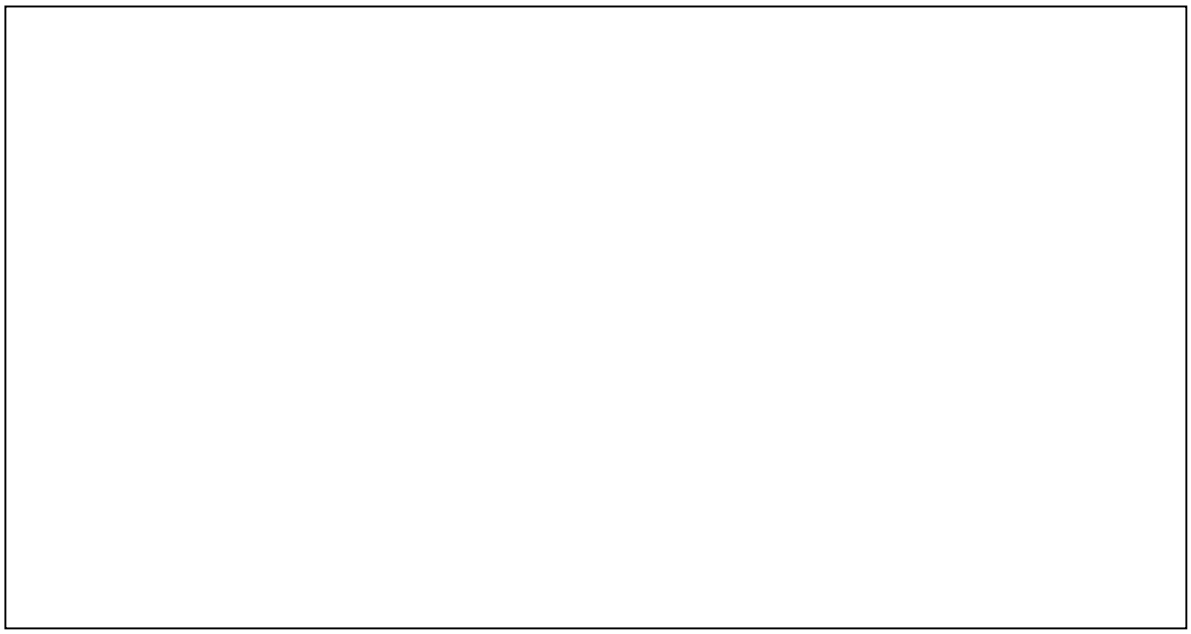
Resources:
Lego/Tufts website- www.ceeo.tufts.edu/curriculum
Lego Dacta "Simple and Motorized Machines" Teacher Guide
Lego Dacta Simple Machine blue building pamphlet #10 (#9630)

Engineer: _____ Date: _____
Partner: _____

Gears and Parrots

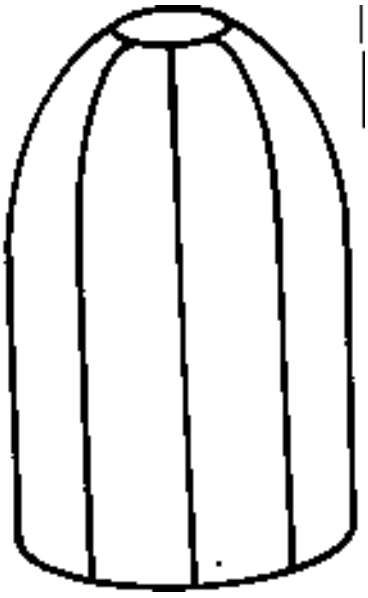
Challenge: To build a gear system that will rotate your parrot/cage paper.

- Draw your idea:



2. Write about your idea:

3. Now share your plans with a partner.



Vocabulary	Building Skills	Programming Skills	Engineering Skills
Grade1			
gears, wheels,	sturdy car that can withstand the drop test (from the knee)	Time programming in Pilot program (forward & back with pulleys)	Exposure to Designing & Drawing
beams (ones with holes) & size (the # of studs)	flick test wall		Communicating ideas (orally)
plates	sturdy gear wall		Building simple prototypes
axles	sturdy pulley wall		Testing
bricks & size (name the # of studs)			Redesigning
			Teamwork & Collaboration
Grade 2			
Axles & Size (# of studs)	Build a sturdy car integrating the RCX in the design	Plan out a Pilot program on paper (cut & paste icons)	Designing a Prototype
Type of gear & size	Build a pulley system to move an object	Program the plan in Robolab	Communicating ideas (orally & in writing)
Connector pegs	Use a worm gear to slow down the motor.	Test & revise program	Testing & Evaluating
Worm gear	Build a slow car using gearing mechanisms	Exposure to Pilot programming with Light & touch sensors	
Bushings	Build a lever		Redesigning

	system to move an object		
Pulley Wheels & belts	Build an inclined plane system to move an object		Teamwork & Collaboration
Levers & Incline Planes	Build a structure that integrates a pulley, lever & inclined plane		

Final Assessment Ideas

The final assessment is an opportunity for the students to share all the various engineering, programming, and building skills they have learned throughout the unit. During the final projects, students should be encouraged to integrate the simple machines covered in this unit. The projects are designed for students to work in pairs to complete one part of the final structure. For example, when building a playground one pair may build a seesaw while another build the merry-go-round. It is helpful for the students to have a building journal where they design, plan out, and reflect on their building during the project. (See attached journal for sample.)

- Design and build a playground
- Design and build a roller coaster
- Design and build the factory from Willy Wonka and the Chocolate Factory
- Design and build the fair from Charlotte's Web
- Design and build a city or town
- Design and build a home with such things as a garage door opener or alarm system