Robotics Engineering
DoDEA Career and Technical Education
Simple and Compound Machines

Area **Competency**
E. **Investigating Simple and Compound Machines**

Task	Task/Skill	Started mm/dd/yy	Completed mm/dd/yy
1.	**Simple and Compound Machines Using LEGOs**	(/ /)	(/ /)

Before you get started, print out this Agenda. The Agenda is your management and progress assessment tool and it covers this entire module of study. **Start at sub-task "a" and proceed through this portion of the checklist. Once you've completed the Pre-Test, go directly to Task 2.** This and the remaining sections form the instructional *meat* of this module. While completing these tasks, you'll learn the content and complete assignments that you'll be tested over so study these lessons carefully. Once you've complete all of the tasks return to this section. Once you've completed all the Tasks and the Learning Log then you must finish the module Practicum and Exam. Please note that you must complete all assigned Subtasks to receive credit for the complete Task. There is no partial credit. Please remember that you're also required to pass the module Practicum and Exam before moving on to the next module.

Upon completing this module, you will identify the basic components of Simple Machines and apply the concepts of Mechanical Advantage, Force and Work. Before you start construction you will identify and inventory the various parts of the robotics trainer. During activities and laboratory experiments, you will collect data and build computational models using spreadsheet software. You will also build models of levers, incline planes, gears, wheels, belts, screws, wedges and pulleys to construct simple machines that perform work applying Mechanical Advantage. Finally, you'll combine various Simple Machines to Create Compound machines that solve real-world problems.

Start

Sub	Init	Time	Type of Task	Task Description
a.	( )	**25 Min**	**Exercise**	**Team Building Initiatives**
b.	( )	**5 Min**	**Exercise**	**Agenda (Print)**
c.	**( )**	**5 Min**	**Exercise**	**Learning Log (Print)**
d.	( )	**10 Min**	**Pre-Test**	**Investigating Simple and Compound Machines**
			Source:	E-PreTest.eot
e.	( )	**5 Min**	**Presentation**	**Investigating Simple and Compound Machines**
			Source:	Presentation. pptx
f.	( )	**15 Min**	**Game**	**Simple Machines and Compound Machines**
			Source:	http://www.edheads.org/activities/simple-machines/
g.	( )	**15 Min**	**Task**	**Mindstorms NXT Inventory**
			Source:	MindstormsNXTInventory.pdf
h.	( )	**45 Min**	**Practicum**	**LEGO Rube Goldberg Machine**
			Source:	Practicum.pdf
i.	( )	**10 Min**	**Review**	**Investigating Simple and Compound Machines**
			Source:	Review.pptx
j.	( )	**20 Min**	**Summarized Notes**	**Investigating Simple and Compound Machines**
			Source:	LearningLog.docx
k.	( )	**10 Min**	**Notebook / Home Folder Folder Review**	
l.	( )	**15 Min**	**Exam**	**Investigating Simple and Compound Machines**
			Source:	E-Exam.eot

Return

Skip To Task 2

STOP

_____ _____
Lastname, First Period

Complete each subtask in the order presented. Your mentor will initial each substask as it's sucessfully completed. You must indicate the task start and completion dates. Submit this form to the instructor as each task area is completed to receive credit.

Task	Task/Skill	Started mm/dd/yy	Completed mm/dd/yy
2.	**Levers**	(/ /)	(/ /)

Resume

At the completion of this task, you will demonstrate the effects of Force, Mechanical Advantage and Work regarding the use of different classes of levers. You'll build models of these devices and then calculate, test, and verify the results of your Simple Machines. You'll enter data into a mathematical model to analyze the trends associated with your designs. You will be able to recognize incline planes and apply variations to solve a variety of problems. To complete the task, you must describe each model in terms of how it works, its similarities to real wolrd examples, and in what situations this type of Simple Machine may be used. You will investigate the effects of various modifications upon each of the models.

Sub	Init	Time	Type of Task	Task Description
a.	( )	**10 Min**	**Game**	**Levers**
			Source:	http://www.vectorpark.com/levers/
b.	( )	**45 Min**	**Exercise**	**Simple and Compound Machines**
			Source:	Exercise 1a – Levers
c.	( )	**20 Min**	**Exercise**	**Mathematical Model**
			Source:	SimpleAndCompoundMachines.xlsx (Lever)
d.	( )	**45 Min**	**Exercise**	**Simple and Compound Machines**
			Source:	Exercise 1b – Levers (Optional)
e.	( )	**25 Min**	**Model**	**Lever, Wheelbarrow, Pliers & Lazytongs**
			Source:	Image Gallery

Task	Task/Skill	Started mm/dd/yy	Completed mm/dd/yy
3.	**Inclined Plane, Wedge and Screw**	(/ /)	(/ /)

At the completion of this task, you will demonstrate the effects of Force, Mechanical Advantage and Work regarding the use of inclined planes, wedges, and screws. You'll build models of these devices and then calculate, test, and verify the results of your Simple Machines. You'll enter data into a mathematical model to analyze the trends associated with your designs. You will be able to recognize inclined planes and apply variations to solve a variety of problems. To complete the task, you must describe each model in terms of how it works, its similarities to real world examples, and in what situations this type of Simple Machine may be used. You will investigate the effects of various modifications upon each of the models.

Sub	Init	Time	Type of Task	Task Description
a.	( )	**15 Min**	**Exercise**	**Inclined Plane, Wedge and Screw**
			Source:	http://www.slideshare.net/jbishopgcms/planewedgescrew
b.	( )	**35 Min**	**Exercise**	**Simple and Compound Machines**
			Source:	Exercise 2 – Inclined Plane, Wedge and Screw
c.	( )	**20 Min**	**Model**	**Inclined Plane, Wedge and Screw**
			Source:	Image Gallery
d.	( )	**25 Min**	**Exercise**	**Mathematical Model**
			Source:	SimpleAndCompoundMachines.xlsx (Inclined Plane)

Task	Task/Skill	Started mm/dd/yy	Completed mm/dd/yy
4.	**Resistance**	(/ /)	(/ /)

At the completion of this task, you will demonstrate the effects of Resistance, Force, Mechanical Advantage and Work while identifying sources of Resistance inherent within Simple Machines. You'll build a model of an Incline Plane and then calculate, test, and verify the affects upon Resistance when operated with and without the use of a transport vehicle. You'll enter data into a mathematical model to analyze the trends associated with your design. You will be able to recognize the affects of Resistance and apply design variations to solve a variety of problems. To complete the task, you must describe the

_____ _____
Lastname, First Period

Complete each subtask in the order presented. Your mentor will initial each substask as it's sucessfully completed. You must indicate the task start and completion dates. Submit this form to the instructor as each task area is completed to receive credit.

model in terms of how it works, its similarities to real world examples, and in what situations this type of Simple Machine may be used. You will investigate the effects of various modifications upon the model.

Sub	Init	Time	Type of Task	Task Description
a.	( )	**25 Min**	**Exercise**	**Resistance**
			Source:	http://www.cosi.org/files/Flash/simpMach/sm1.swf
b.	( )	**30 Min**	**Exercise**	**Simple and Compound Machines**
			Source:	Exercise 3 – Resistance
c.	( )	**30 Min**	**Model**	**Resistance**
			Source:	Image Gallery
d.	( )	**25 Min**	**Exercise**	**Mathematical Model**
			Source:	SimpleAndCompoundMachines.xlsx (Resistance)

Task	Task/Skill	Started mm/dd/yy	Completed mm/dd/yy
5.	**Wheel and Axle**	(/ /)	(/ /)

At the completion of this task, you will demonstrate the effects of Force, Mechanical Advantage and Work regarding the use of the Wheel and Axle. You'll measure these devices and then calculate and compare your results with models of your Simple Machine. You'll complete a mathematical model to analyze the trends associated with various sizes of Wheels and Axles. You will be able to recognize types of wheels and axles and apply variations to solve a variety of problems. To complete the task, you must describe each model in terms of how it works, its similarities to real world examples, and in what situations this type of Simple Machine may be used. You will investigate the effects of various modifications upon each of the models.

Sub	Init	Time	Type of Task	Task Description
a.	( )	**5 Min**	**Exercise**	**Wheel and Axle**
			Source:	http://teacher.scholastic.com/dirtrep/simple/wheel.htm
b.	( )	**35 Min**	**Exercise**	**Simple and Compound Machines**
			Source:	Exercise 4 – Wheel and Axle
c.	( )	**20 Min**	**Model**	**Wheel and Axle**
			Source:	Image Gallery
d.	( )	**25 Min**	**Exercise**	**Mathematical Model**
			Source:	SimpleAndCompoundMachines.xlsx (Wheel and Axle)

Task	Task/Skill	Started mm/dd/yy	Completed mm/dd/yy
6.	**Belt Drive**	(/ /)	(/ /)

At the completion of this task, you will demonstrate the effects of Force, Mechanical Advantage and Work regarding the use of Belt Drive. You'll build models of these devices and then calculate, test, and verify the results of your Simple Machines. You'll complete and enter data into a mathematical model to analyze the trends associated with your designs. You will be able to recognize different types of belt drives and apply various configurations to solve a variety of design problems. To complete the task, you must describe each model in terms of how it works, its similarities to real world examples, and in what situations this type of Simple Machine may be used. You will investigate the effects of various modifications upon each of the models.

Sub	Init	Time	Type of Task	Task Description
a.	( )	**5 Min**	**Exercise**	**Belt Drive**
			Source:	http://en.wikipedia.org/wiki/Belt_(mechanical)
b.	( )	**35 Min**	**Exercise**	**Simple and Compound Machines**
			Source:	Exercise 5 – Belt Drive

_____ _____
Lastname, First Period

Complete each subtask in the order presented. Your mentor will initial each substask as it's sucessfully completed. You must indicate the task start and completion dates. Submit this form to the instructor as each task area is completed to receive credit.

c. ( ) **20 Min** **Model** **Belt Drive**
Source: Image Gallery

d. ( ) **25 Min** **Exercise** **Mathematical Model**
Source: SimpleAndCompoundMachines.xlsx (Belt Transmission)

Task Task/Skill Started mm/dd/yy Completed mm/dd/yy

7. Gears and Gear Ratios (/ /) (/ /)

At the completion of this task, you will demonstrate the effects of Force, Mechanical Advantage and Work regarding the use of Gears and Gear Ratios. You'll build models of these devices and then calculate, test, and verify the results of your Simple Machines. You'll complete and enter data into a mathematical model to analyze the trends associated with your designs. You will be able to recognize types of gears and tooth count, gear ratio and transmission angle. You'll also combine gears to solve a variety of design problems. To complete the task, you must describe each model in terms of how it works, its similarities to real world examples, and in what situations this type of Simple Machine may be used. You will investigate the effects of various modifications upon each of the models.

Sub Init Time Type of Task Task Description

a. ( ) **5 Min** **Exercise** **Gears and Gear Ratios**
Source: http://sariel.pl/2009/09/gears-tutorial/

b. ( ) **35 Min** **Exercise** **Simple and Compound Machines**
Source: Exercise 6 – Gears and Gear Ratios

c. ( ) **20 Min** **Model** **Gears and Gear Ratios**
Source: Image Gallery

d. ( ) **25 Min** **Exercise** **Mathematical Model**
Source: SimpleAndCompoundMachines.xlsx (Gears & Gear Ratios)

Task Task/Skill Started mm/dd/yy Completed mm/dd/yy

8. Gear Trains (/ /) (/ /)

At the completion of this task, you will demonstrate the effects of Force, Mechanical Advantage and Work regarding the use of Gear Trains. You'll build models of these devices and then calculate, test, and verify the results of your Simple Machines. You'll modify a spreadsheet and enter data into a mathematical model to analyze the trends associated with your designs. You will be able to recognize the component parts and configuration of Gear Trains. You'll also calculate the Gear Train's gear ratio, Mechanical Advantage, Input and Output Speeds and Torques. You'll also combine gears to solve a variety of design problems. To complete the task, you must describe each model in terms of how it works, its similarities to real world examples, and in what situations this type of Simple Machine may be used. You will investigate the effects of various modifications upon each of the models.

Sub Init Time Type of Task Task Description

a. ( ) **5 Min** **Exercise** **Gear Trains**
Source: http://bowlesphysics.com/images/Robotics_-_Gears_and_Gear_Ratios.pdf

b. ( ) **35 Min** **Exercise** **Simple and Compound Machines**
Source: Exercise 7 – Gear Trains

c. ( ) **20 Min** **Model** **Gear Trains**
Source: Image Gallery

d. ( ) **25 Min** **Exercise** **Mathematical Model**
Source: SimpleAndCompoundMachines.xlsx (Gear Trains)

_____ _____
Lastname, First Period

Complete each subtask in the order presented. Your mentor will initial each substask as it's sucessfully completed. You must indicate the task start and completion dates. Submit this form to the instructor as each task area is completed to receive credit.

Task	Task/Skill	Started mm/dd/yy	Completed mm/dd/yy
9.	**Pulleys and Pulley Systems**	(/ /)	(/ /)

At the completion of this task, you will demonstrate the effects of Force, Mechanical Advantage and Work regarding the use of Pulleys and Pulley Systems. You'll build models of these devices and then calculate, test, and verify the results of your Simple Machines. You'll create and enter data into a mathematical model to analyze the trends associated with your designs. You will be able to recognize the component parts and configuration of different Pulley Systems. You'll also calculate the Pulley System's Mechanical Advantage and the tradeoffs for the reduction of input force. You'll also combine Pulleys to solve a variety of design problems. To complete the task, you must describe each model in terms of how it works, its similarities to real world examples, and in what situations this type of Simple Machine may be used. You will investigate the effects of various modifications upon each of the models.

Sub	Init	Time	Type of Task	Task Description
a.	( )	**5 Min**	**Exercise**	**Pulleys and Pulley Systems**
			Source:	http://www.dynamicscience.com.au/tester/solutions/hydraulicus/pulleys.htm
b.	( )	**35 Min**	**Exercise**	**Simple and Compound Machines**
			Source:	Exercise 8 – Pulleys and Pulley Systems
c.	( )	**20 Min**	**Model**	**Pulleys and Pulley Systems**
			Source:	Image Gallery
d.	( )	**25 Min**	**Exercise**	**Mathematical Model**
			Source:	SimpleAndCompoundMachines.xlsx (Pulleys)

Task	Task/Skill	Started mm/dd/yy	Completed mm/dd/yy
10.	**Transmission of Motion**	(/ /)	(/ /)

At the completion of this task, you will demonstrate the various Transmissions of Motion. You'll build models of these devices and demonstrate how linkages are used to convert one form of motion to another. To complete the task, you must describe each model in terms of how it works, its similarities to real world examples, and in what situations this type of Simple Machine may be used. You will investigate the effects of various modifications upon each of the models.

Sub	Init	Time	Type of Task	Task Description
a.	( )	**35 Min**	**Exercise**	**Simple and Compound Machines**
			Source:	Exercise 9 – Transmission of Motion
b.	( )	**45 Min**	**Model**	**Transmission of Motion**
			Source:	Image Gallery

Task	Task/Skill	Started mm/dd/yy	Completed mm/dd/yy
11.	**Centrifugal Force and Motion**	(/ /)	(/ /)

At the completion of this task, you will demonstrate how Simple Machines use Centrifugal Force and Motion to solve design problems. You'll build models of various devices that use Centrifugal Force and Motion to operate. To complete the task, you must describe each model in terms of how it works, its similarities to real world examples, and in what situations this type of Simple Machine may be used. You will investigate the effects of various modifications upon each of the models.

Sub	Init	Time	Type of Task	Task Description
a.	( )	**35 Min**	**Exercise**	**Simple and Compound Machines**
			Source:	Exercise 10 – Centrifugal Force and Motion
b.	( )	**45 Min**	**Model**	**Centrifugal Force and Motion**
			Source:	Image Gallery

_____ _____
Lastname, First Period

Complete each subtask in the order presented. Your mentor will initial each substask as it's sucessfully completed. You must indicate the task start and completion dates. Submit this form to the instructor as each task area is completed to receive credit.

Task	Task/Skill	Started mm/dd/yy	Completed mm/dd/yy
12.	**Steering Mechanisms**	(/ /)	(/ /)

At the completion of this task, you will demonstrate how Simple Machines can be configured to create Steering Mechanisms for various types of vehicles to solve design problems. You'll build models of various devices that use linkages to facilitate Steering Mechanisms. To complete the task, you must describe each model in terms of how it works, its similarities to real world examples, and in what situations this type of Simple Machine may be used. You will investigate the effects of various modifications upon each of the models.

Sub	Init	Time	Type of Task	Task Description
a.	( )	**35 Min**	**Exercise**	**Simple and Compound Machines**
			Source: Exercise 11 – Steering Mechanisms	
b.	( )	**45 Min**	**Model**	**Steering Mechanisms**
			Source: Image Gallery	

Task	Task/Skill	Started mm/dd/yy	Completed mm/dd/yy
13.	**Compound Machines**	(/ /)	(/ /)

At the completion of this task, you will demonstrate how Simple Machines are combined to produce Compound Machines. You'll build models of various devices that incorporate the functions of different types of Simple Machines to solve design problems. To complete the task, you must describe each model in terms of how it works, its similarities to real world examples, and in what situations this type of Simple Machine may be used. You will investigate the effects of various modifications upon each of the models.

Sub	Init	Time	Type of Task	Task Description
a.	( )	**35 Min**	**Exercise**	**Simple and Compound Machines**
			Source: Exercise 12 – Compound Machines	
b.	( )	**45 Min**	**Model**	**Compound Machines**
			Source: Image Gallery	

Task	Task/Skill	Started mm/dd/yy	Completed mm/dd/yy
14.	**Forms of Energy**	(/ /)	(/ /)

Students will use their robotic trainer to construct a working model of a catapult, slingshot, or trebuchet. Demonstrating the properties of potential and kinetic energy, students will measure the amount of stored energy and compare their results to other teams in the classroom. Desired qualities include distance, accuracy, and repeatability.

Sub	Init	Time	Type of Task	Task Description
a.	( )	**15 Min**	**Research Assignment**	**Potential and Kinetic Energy**
			Source: Web Search	
b.	( )	**45 Min**	**Exercise**	**Forms of Energy – Catapult/Trebuchet**
			Source: Exercise 12 – Simple and Compound Machines	

Return

_____ _____
Lastname, First Period

Complete each subtask in the order presented. Your mentor will initial each substask as it's sucessfully completed. You must indicate the task start and completion dates. Submit this form to the instructor as each task area is completed to receive credit.