Backwards Design Unit Planning

New York City Department of Education
Magnet Program District 25 & 28

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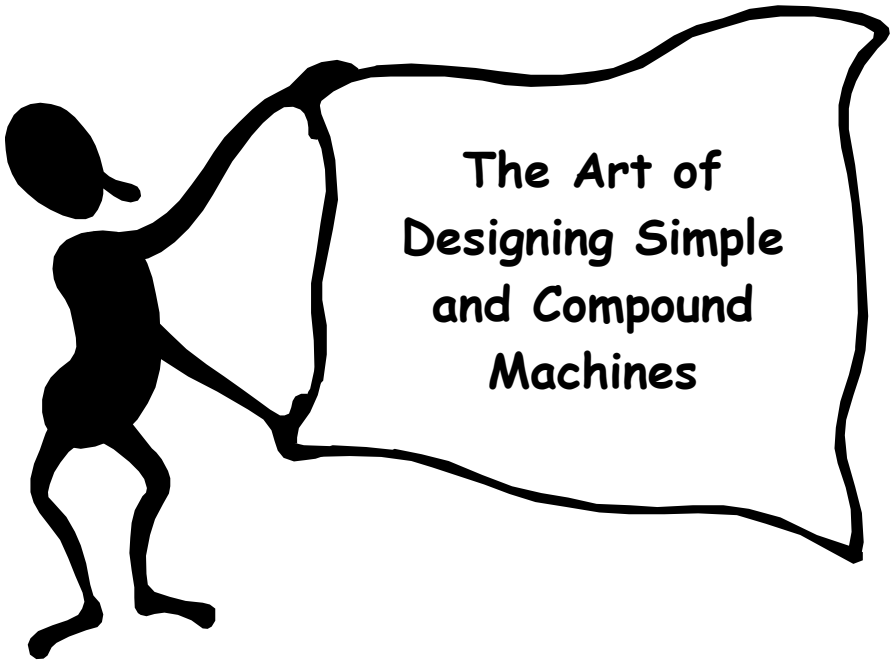

Essential Question: How can designing simple and compound machines helps us face challenges in life?

Suggested Time Frame: Four weeks

Theme: The Arts

Graphic Overview of Unit

Suggested Time Frame: Four weeks

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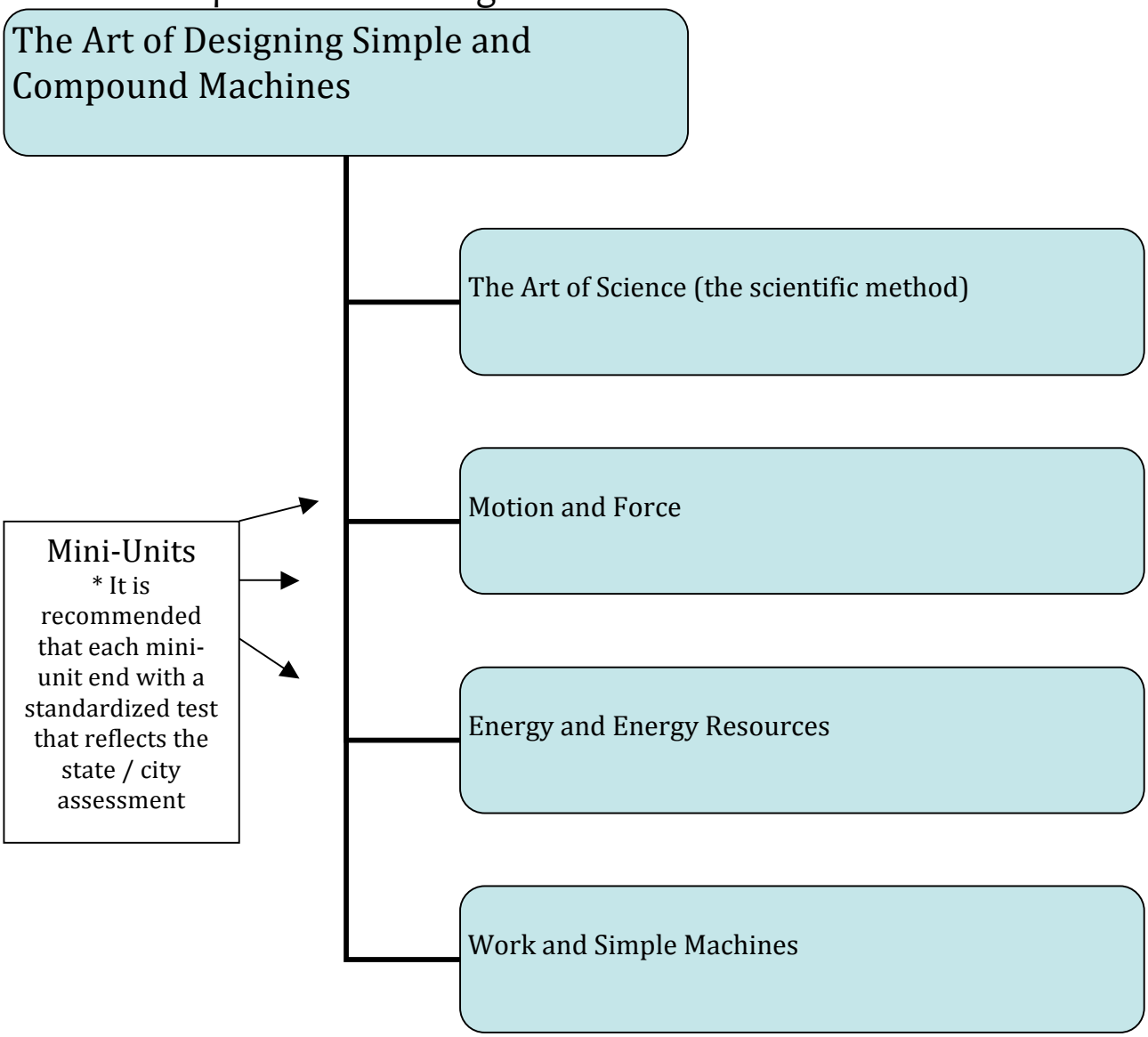
Essential Question: How can designing simple and compound machines help us face challenges in life?



Unit's Culminating Project: (briefly explain in 2-3 sentences):

Students will do research on different aspects of robotics (walking machines, robotic arms, etc.) to show how machines can help people live their daily lives and face great challenges. The students will then play the roles of doctors and engineers who are asked to design machines that will help earthquake victims from Haiti and Chile adapt to the new challenges they face. Students must draft designs, build models of simple or compound machines, and explain how these machines will help make the lives of the victims easier.

Stage 1- Desired Results

Standards-Based Learning Goals:

PS4.1e, PS4.1d, PS5.2c, PS5.2f, PS5.2g, PS4.1c, Ps4.5a,b, PS5.2d,e

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Concepts	
Big Ideas for this Unit • Connection • Interaction • Adaptation • Survival • Challenge • Form and function	**Magnet School Theme**: Magnet School for the Arts **How does the Big Idea in your unit connect to your theme?** The culminating project relates to our magnet theme because students must use basic design skills, such as drawing and 3-d artistic construction, to design and build machines that will help people face challenges in life.
Enduring Understandings • Machines are the result of the **connections** and **interactions** between many forces • People use machines to help them **survive** and **adapt** to the **challenges** of everyday life. • The **form** of a machine is influenced by its **function**.	**Overarching Essential Question: (this question should connect to your school theme)** How do machines **function**? What would you do if you lost one of your senses---the ability to see, hear, walk, or talk? How can machines help us **adapt** to these **challenges**? How do you figure out what your machine should look like? How is the "look" or **form** of a machine influenced by the job it must do (**function**)? How can you be creative when designing machines?
Content and Skills	
Content **Students will know…** • Scientific method	**Skills** **Students will be able to…** • Identify the steps of the scientific

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• Science skills • Velocity • Acceleration and deceleration • Force • Friction • Newton's three laws of motion • Energy and the two basic energies • Types of energy • Transformation of energy • Work and power • Five types of simple machines • Mechanical advantage • Efficiency • Robotics, bionics, prostheses	method in order to design machines • Recognize the difference between observation and inference • Explain what energy is. • Distinguish between PE and KE. • Identify the various forms of energy • Apply the law of conservation of energy to energy transformations • Describe how electric power plants produce energy • Explain what renewable and alternative resources are • Recognize when work is done • Explain the relationship between work and power • Calculate how much work is done and power used • Distinguish among the different simple machines • Design machines based on research about robotics, bionics and prostheses, and a knowledge of the principles of force, motion, and energy

Stage 2- Summative Assessment Evidence **If students understand, know and are able to do the items in Stage 1, they should be able to show their understanding by completing an authentic task found in the world beyond the classroom.**
➢ Design the Culminating/Summative Task: ➢ Please note: The Essential Question and the Grasp are interconnected. The

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GRASP is a way for students to demonstrate their knowledge and understanding unit by answer of the Essential Question. Or you can say, they are answering the essential question through their GRASP.

G- (goal): You will work with a partner or a small team to design a machine that will make life easier for the earthquake victims of Haiti and Chile.

R- (role): You are either an engineer or a doctor.

A- (audience): The earthquake victims of Haiti and Chile, your community and beyond.

S- (situation): Five people who were injured by the earthquakes in Haiti and Chile were transported to a hospital in New York. Two of them had to get one of their arms amputated. You are a doctor and your partner is an engineer who specializes in robotics. You are going to work together to help these two people by creating Mytoelectric arms (a battery-powered device that connects muscle nerves in an amputated arm to a sensor) that are effective prostheses, or by designing another type of machine that will help them face the new challenges that they must overcome as a result of the earthquake.

P- (purpose and product):

- You have to research different aspects of robotics, such as walking machines and robots that perform planetary exploration, to show how machines can help people do

extraordinary things and live their daily lives, even when they are facing great challenges.

- You will:
  - Write a one page report based on your research.
  - Design and create a machine (simple or compound).
  - Present your report and these machines to the rest of the class

S- (standards for performance):

- The report:
  - Must have a title
  - Must have at least three paragraphs that describe: the functions of the machine, what it is used for, and how all parts connect and interact with each other
  - Must be typed.
- During the presentation you should:
  - Speak clearly and loudly enough to connect and interact with your audience.
  - Have eye contact and interact with your audience
  - Be rehearsed and prepared to answer questions about how your machine will help the victims adapt to their challenges.
- The model should:
  - Be three dimensional
  - Have all parts labeled
  - Have parts that connect and interact with each other
  - Help the victims adapt to their challenges

Student Task

In the space below, write the task exactly as students will see it.

Dear Doctors and Engineers,

The people of Haiti and Chile desperately need your help. Five people who were injured by earthquakes there were transported to a hospital in New York. Two of them had to get one of

their arms amputated. You and a partner, who specializes in robotics, are going to work together to help these two people by creating Mytoelectric arms (battery-powered devices that connect muscle nerves in amputated arms to sensors), or by creating another type of machine that is effective in helping them adapt to their new challenges.

You and your team will have to research different aspects of robotics, such as walking machines and robotic arms, to help these people live their daily lives without the use of their arm.

Before your machine is approved for the patients, you must present it, along with a report, to a team of specialists.

- You will:
  - Write a one page report based on your research.
  - Design and create a machine (simple or compound).
  - Present your report and these machines to the rest of the class
- The report:
  - Must have a title
  - Must have at least three paragraphs that describe: the functions of the machine, what it is used for, and how all parts connect and interact with each other
  - Must be typed.
- During the presentation you should:
  - Speak clearly and loudly enough to connect and interact with your audience.
  - Have eye contact and interact with your audience
  - Be rehearsed and prepared to answer questions about how your machine will help the victims adapt to their challenges.
- The model should:
  - Be three dimensional
  - Have all parts labeled
  - Have parts that connect and interact with each other
  - Help the victims adapt to their challenges

Thank you for your help. Your expertise with medicine and robotics will ease the pain of these earthquake victims and help them adapt to the challenges that lie ahead.

Sincerely,

The Ambassador of Haiti

Rubric for the culminating project

Level	Knowledge **Knows and understand scientific terms, facts, concepts**	Application **Applies scientific knowledge, skills to analyze , create and evaluate**	Communication **Communicates scientific knowledge and applications through writing, speech and visual display**

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4	Descriptions of knowledge are complete and correct	Applications are thorough, appropriate and accurate.	Written, oral and visual communication is well organized and effective.
3	Descriptions are mostly complete and correct	Applications are appropriate and accurate.	Most of the written, oral and/ or visual communication is well organized and effective.
2	Descriptions are some- what complete and correct.	Applications are some -what appropriate and accurate.	Some of the written, oral and/or visual communication is organized and effective.
1	Descriptions are incomplete and incorrect.	Applications are minimally appropriate and accurate.	Little of the written, oral and/or visual communication is organized and effective.

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Unit's Essential Question: How can machines help us face challenges in life?

Mini-Unit Title (each mini-unit is approx 1 week long)	**Big ideas of the mini-unit /** concept statement (macro) What is the big idea of this mini-unit?	**Key Content /Knowledge** (Important Content to Know about, vocabulary, the specifics) (Micro)	***Skills*** What should the students be able to do? (rule of thumb - skills are verbs – knowledge is a noun*)*	**List of Topical / Content Based Questions** (make sure to amend the essential question so that it becomes topical for this mini-unit)	**Mini-Unit Assessment** (must be aligned to the NYS / NYC exams. It can be a test or a quiz - i.e.: DBQ Essay; 10 multiple choice questions; or 3 constructed response questions)	**Scaffolding towards the culminating project** (what can be done during this mini-unit to develop the stage 2 culminating assessment (grasp)
The nature and art of science	**Connection Interaction**	**Scientific method**	**Identify…… Recognize……**	**Why can't science answer questions with certainty?** **Why do scientists share information?**	**Quiz- 10 multiple choice Test – 10 multiple choice, 6 constructed response questions.**	**The students will write a lab report using the scientific method. This will help them to understand the process for designing their machines**
Motion and force	**Function Interaction Connection**	**Velocity Acceleration Force Newton's three laws of motion**	**Calculate…. Identify……. Distinguish ….. Explain … Five problems related to force and**	**How are velocity, acceleration and force connected? How do they interact? How do**	**Quiz- 10 multiple choice and 10 fill in the blanks.**	**The students will do an experiment with balloons that prove**

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			Newton's three laws of motion.	Newton's 3 laws of motion affect how things function?		Newton's third law of motion.
Energy and energy resources	Function Interaction Connection	Types of energy Transformation of energy Energy resources PE and KE	Explain.. Distinguish ….. Identify…… Apply… Describe…. Types of energy (PE and KE), energy resources and transformations	How are chemical energy and thermal energy connected? What interactions must take place to convert chemical to thermal energy? Why is it beneficial to look at many different types of energy sources, such as fossil fuels, hydroelectricity and solar energy? How do they function differently? What are advantages and disadvantages of each?	Test- 10 multiple choice , 6 constructed response questions	Students will do a lab that shows how work can be done and how much power can be used when the work is being done. This will help students design their own simple machines by showing them how to measure the amount of power and energy used by their machine.

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Work and simple machines	**Function Challenges Survival Adaptation Connection Interaction**	**Work Power Simple machines**	**Students will calculate the amount of work being done and power used** **Students will recognize, describe and distinguish the differences between various simple machines** **Students will analyze and draw various simple machines**	**How can simple machines help people adapt to simple challenges?** **A doorknob is an example of a wheel and axle. Why is turning a knob easier than turning an axle? How do a wheel and axel interact?** **How can work be performed on an object?**	**Test- 10 multiple choice, 6 extended response questions.**	**The students did three labs where they created a lever, a inclined plane and a pulley and showed how these simple machines can make your work and life easier.**

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A Week at a Glance – Copy as Necessary

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WHERE is the student going and what is expected HOOK with needed skills to experience and explore Opportunity to REVISE and RETHINK their understanding	Allow students to EVALUATE wor TAILOR work to student needs Be ORGANIZED to maximize enga

Monday	Tuesday	Wednesday	Thursday
Content Focus: How can science help us face the challenges of everyday life? Hook: The culminating project, model of project . Make a hypothesis about how science and life are related? Daily Assessment: Write five examples where you science in your daily life.	Content Focus: How do we solve problems using the scientific method? Hook: Before you are able to start with the project, what do you think you need to know about science? Daily Assessment: State a problem and solve it using the scientific method.	Content Focus: How do we calculate the speed of an object?(lab) Hook: Give some data that relates to earthquakes? Make some inferences. Why is it important to analyze your data table? Daily Assessment: Write a lab report.	Content Focus: How is accelera different from deceleration? Hook: How is speed d from velocity? velocity relatec machines? Daily Assessme Solve the probl given on the homework web

Weekly Assessment (must be aligned to the NYS / NYC exams):
Answer questions25, 26, 27, 28 and 29 on page 37.

What have the students produced that scaffolds towards the units culminating assessment?
(for example if the unit's culminating assessment is a newspaper – perhaps the students have written an article)
Student wrote a lab report using the scientific method.

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: *A Week at a Glance – Copy as Necessary*

WHERE is the student going and what is expected HOOK with needed skills to experience and explore Opportunity to REVISE and RETHINK their understanding			Allow students to EVALUATE wor TAILOR work to student needs Be ORGANIZED to maximize enga
Monday	Tuesday	Wednesday	Thursday
Content Focus: How do we show that for every action there is an equal and opposite reaction?(lab) Hook: Define force. Give some examples where you see the Newton's third law of motion in machines. Daily Assessment: Write a lab report.	Content Focus: How is mass different from weight? (lab) Hook: Define gravity. Do you think that gravity come in action when we deal with machines? Explain. Daily Assessment: Write a lab report.	Content Focus: What are the two basic forms of energy? Hook: Define energy. Name some energies that you see when machines is in action. Daily Assessment: Compare and contrast PE and KE.	Content Focus: What are the di types of energy Hook: An object that mass of 20kg is with a velocity 60km/hr. Calcu KE of the objec see KE when m is in motion? Daily Assessme Read pages 44 Write a one pag summary.

Weekly Assessment (must be aligned to the NYS / NYC exams):
Answer questions 1 to 6 on page 46.
Answer questions 20 to 29 on page 69.

What have the students produced that scaffolds towards the units culminating assessment?
(for example if the unit's culminating assessment is a newspaper – perhaps the students have written an article)
Students wrote two lab reports using the scientific method. **Students did an experiment with balloons th law of motion. Students did an experiment with balloons that proved the Newton's third la experiment with balloons that proved the Newton's third law of motion. Students did an e proved the Newton's third law of motion.**

A Week at a Glance – Copy as Necessary

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WHERE is the student going and what is expected HOOK with needed skills to experience and explore Opportunity to REVISE and RETHINK their understanding	Allow students to EVALUA TAILOR work to Be ORGANIZED to m

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Monday	Tuesday	Wednesday	Thursda
Content Focus: How do we solve problems related to work? Hook: Define work. When a machines is in action is there any being work done. Daily Assessment: Read page 76. Solve questions 1 and 2 on page 76.	Content Focus: How do we solve problems related to to power? Hook: Define power. When a machine is in action is, is any power is being used. Daily Assessment: Read page 77. Solve questions 1 and 2 on page77.	Content Focus: How do we calculate work and power? (lab) Hook: Write the formula for work and power. Why do you think machine , work and power are related? Daily Assessment: Write a lab report.	Content Focus: What are the di types of lever? Hook: Define machine Describe the m you plan to cre Daily Assessme Draw and label three different energy.

Weekly Assessment: (must be aligned to the NYS / NYC exams):
Answer questions 1 to 7 on page 78.

What have the students produced that scaffolds towards the units culminating
(for example if the unit's culminating assessment is a newspaper – perhaps the students h

The students did an experiment that showed how work can be measured and how much power c
done.

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A Week at a Glance – Copy as Necessary

:

WHERE is the student going and what is expected HOOK with needed skills to experience and explore Opportunity to REVISE and RETHINK their understanding	Allow students to EVALUA TAILOR work to Be ORGANIZED to ma

Monday	Tuesday	Wednesday	Thursda
Content Focus: What is wheel and axle? Hook: Define wheel and axle. Why is wheel and axle a machine? Daily Assessment: Write a summary of what you learned today.	Content Focus: What are the types of pulley? Hook: Define pulley. Why is pulley a machine? Daily Assessment: Write a summary of what you learned today.	Content Focus: How do we calculate the MA of a lever?(lab) Hook: Define MA. Define the MA of a lever. Daily Assessment: Write a lab report.	Content Fo How do we ca the MA of a in plane? (la Hook: Define the MA inclined plane. Daily Assessme Write a lab rep

Weekly Assessment: (must be aligned to the NYS / NYC exams):
Answer questions 20 to 31 on page 97.

What have the students produced that scaffolds towards the units culminating
(for example if the unit's culminating assessment is a newspaper – perhaps the students ha
The students did three labs where they created a lever, a inclined plane and a pulley and showed h
can make work easier.

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Unit Resources:

Books:
New York Science
Understanding by Design professional development workshop(Jay McTighe and Grant Wiggins)
Understanding by design expanded 2nd edition(Jay McTighe and Grant Wiggins)

Websites:
www.acuite.com
www.edhelper.com
www.google.com
www.glencoe.com
www.phschool.com
www.teachertube.com

Teacher Materials:
Chart Paper
Lab Materials
Calculators
Rulers, scissors, cardboard, Styrofoam, construction paper, glue, markers, etc.

Other: