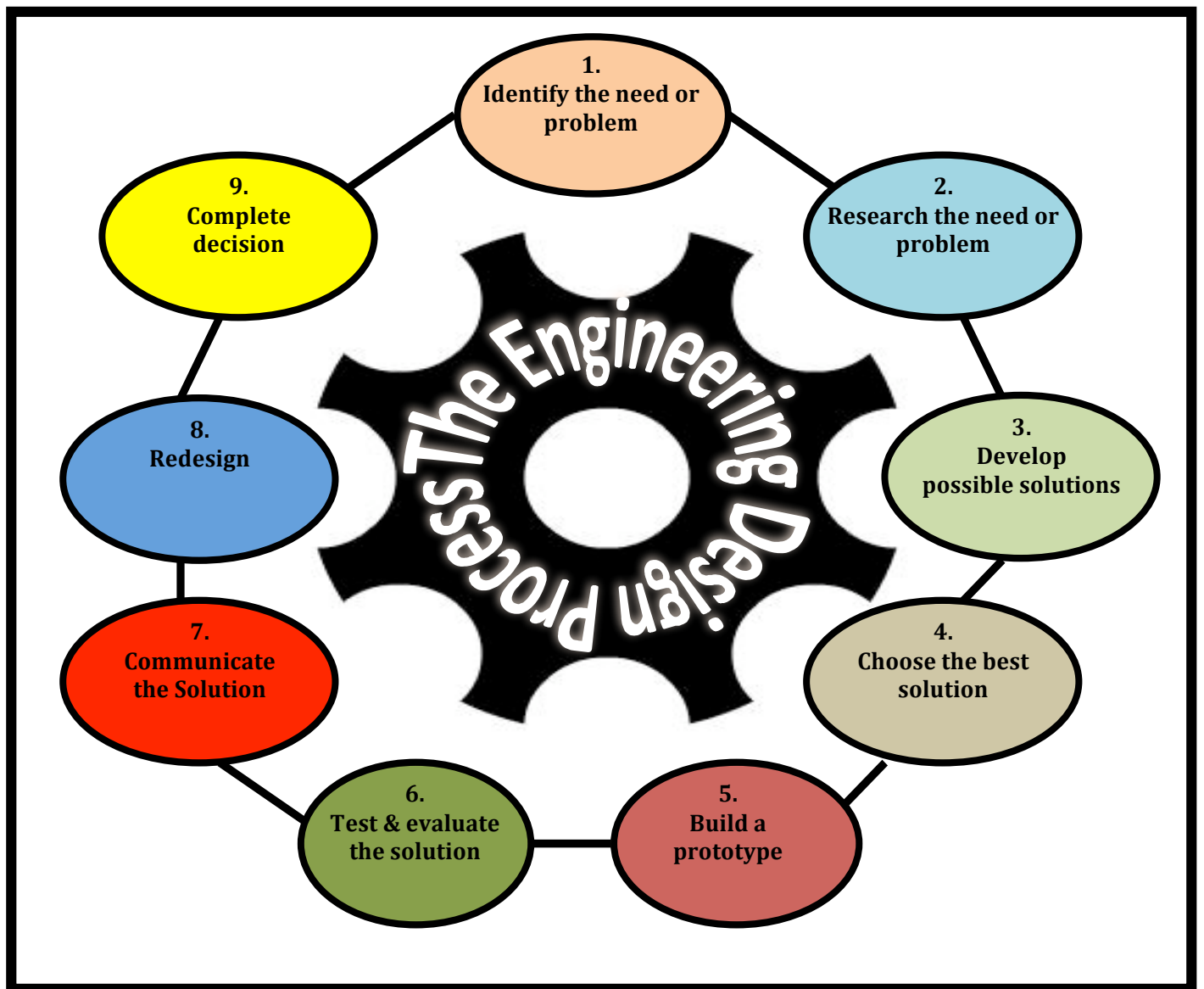


# Applied Technology & Engineering



## MOUSETRAP CAR- IT'S A SNAP!



Name: \_\_\_\_\_

Section: \_\_\_\_\_

# Mousetrap Car

## DESIGN CHALLENGE

>> Design and build a car powered by a mousetrap that will travel a minimum distance of 3 meters.

### Criteria

Your vehicle must:

- Use a single mousetrap for propulsion
- Have a wooden base or chassis (*cha-see*)
- Travel a minimum of 3 meters (straight line)
- Have at least 3-4 wheels
- Have repeatable functioning (not breakdown)

### Constraints

Your car must not exceed:

- **Max Length** - 45 cm
- **Max Width** - 20 cm
- **Max Height** - 20 cm

### Approved Materials

- 1 standard mousetrap.....\$500
- Wood base.....\$100
- Rubber bands.....\$10 ea.
- Mechanical fasteners (screws, screw-eyes).....\$25 ea.
- Large wheels.....\$50 ea.
- Small wheel.....\$25 ea.
- Metal axle.....\$25 ea.
- Tie wraps.....\$10 ea.
- Fishing line.....\$1/ft.
- Straws.....\$20 ea.
- Other:

### Key Points

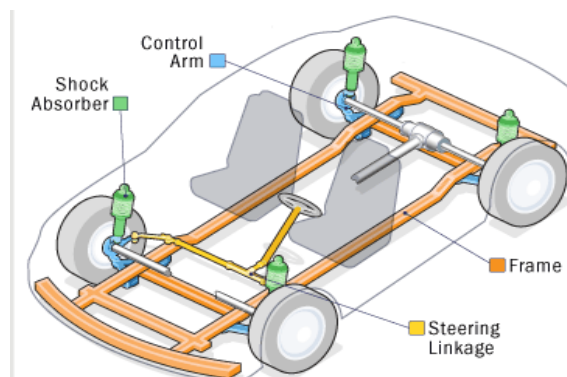
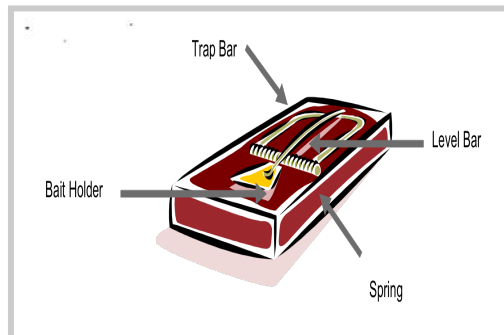
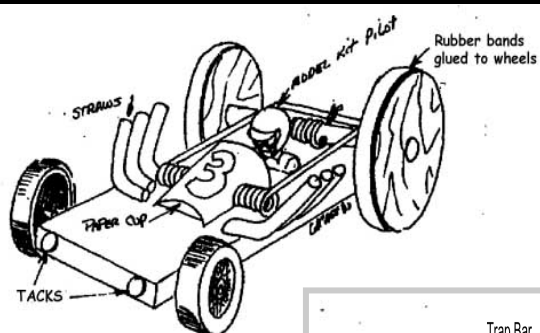
You will get a budget of **\$1,500** to buy materials and have three opportunities to purchase them. The price will increase each time due to inflation. Plan wisely so you don't run out of money and don't buy too much, extra merchandise **CANNOT** be returned.

### Key Terms

- **Alignment:** to be arranged in a straight line.
- **Chassis**-the base of the vehicle that all other parts are built upon.
- **Control**- changes the speed and direction of the vehicle.
- **Friction:** a force that slows down an object.
- **Guidance**- gives the operator information to control the vehicle.
- **Propulsion**- makes the vehicle move.
- **Structure**-gives the vehicle its shape and size.
- **Suspension**- keeps the vehicle in contact with the road.

### Competition Guidelines

- The track will be 1 meter wide. If the vehicle leaves the boundaries of the track, the distance will be marked where any part of the vehicle leaves the track boundary.
- The distance the vehicle travels will be measured from the starting line to the front of the vehicle.
- To start your vehicle, the trap must be set. A weight will be dropped on the bait holder. If the coin or bait holder malfunctions, that run will not count.



**ENGINEERING DESIGN PROCESS**  
**STEP 1: Identify the Need**

*Technology is a product (thing) or process (how to do something) made by humans to meet their needs.*

**Restate the purpose of this design challenge** (What have you been asked to do?)

**What does this prototype have to do to be successful?**

**Use #2 pencil ONLY!**

**Which of the five needs below are met by this projects' technology?** (Check off all that apply and explain.)

☐ **1. Improve the way we communicate.** Explain how: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

☐ **2. Improve the way we travel.** Explain how. \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

☐ **3. Improve the way we work.** Explain how: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

☐ **4. Improve the way we entertain ourselves.** Explain how: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

☐ **5. Improve people's health.** Explain how: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

**ENGINEERING DESIGN PROCESS**  
**STEP 2: Research**



**Directions:** Use the web links for this project to answer the following questions

**1.**

What is energy?

**2..**

How is energy stored in a mousetrap?

**3.**

What is friction and how does it affect a car?

**4.**

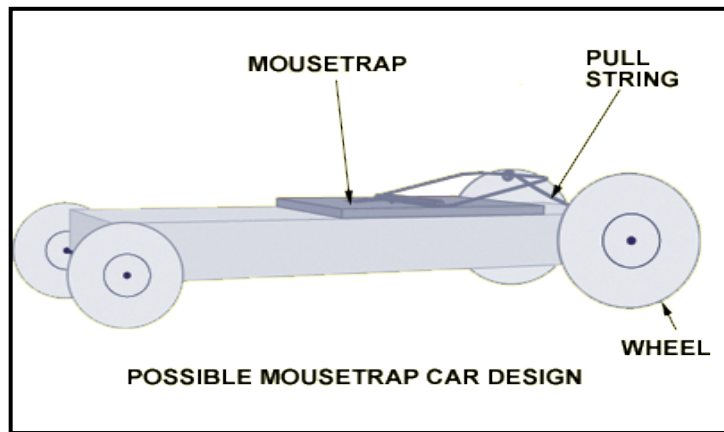
What makes the mousetrap car move?

**5.**

What is the key to a quick start?

**ENGINEERING DESIGN PROCESS**  
**STEP 3: Develop possible solutions**

Draw three **DIFFERENT** solutions to this design challenge



**PROTOTYPE #1**

**PROTOTYPE #2**

**PROTOTYPE #3**

## ENGINEERING DESIGN PROCESS


### STEP 4: Choose the best solution

When you have an important decision to make and you want to reduce or eliminate the chances of second-guessing yourself, (*I shouldda done that*), you make decisions based on trade-offs. That's when you give up something you like for something that's even better. Here are some benefits you can expect:

- You understand how and why you choose one solution over another.
- Your decision fits with your success criteria and needs.
- You use logic rather than emotion to make the decision.
- You get a chance to think about what you really want.

Look at the questions in the left –hand column. Give each idea a number from 1-5 based on how close it comes to the criteria. (1 is the lowest value and 5 is the highest value).

<b>DECISION MATRIX</b> <b>Make the “perfect” decision every time</b>	Possible Solutions					
<b>AERODYNAMICS</b> (On a scale from 1-5...) Will this design minimize drag?						
<b>FRICTION</b> (On a scale from 1-5...) Will this design maximize friction between the tires and ground?						
<b>ASTHETICS</b> (On a scale from 1-5...) Does this design look “cool”? Does it attract attention? Is it unique?						
<b>ASTHETICS</b> (On a scale from 1-5...) Does this design look “cool”? Does it attract attention? Is it unique						
<b>MATERIALS</b> (On a scale from 1-5...) Does this design use approved materials in new and unique ways that others may not think of?						
<b>TOTALS</b>						

	And the winner is...
	<hr/>

## ENGINEERING DESIGN PROCESS STEP 4: Choose the best solution



Explain your choice on the lines below.

*A successful explanation will have:*

- ☐ A topic sentence that says what you are about to describe/explain and a closing sentence that restates your main idea.
- ☐ Several complete sentences that gives the reader enough information (three reasons) to understand your choice
- ☐ Proper grammar, spelling and punctuation
- ☐ Lettering that is legible and evenly spaced between words and sentences

**1<sup>st</sup> Reason:**

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**Detail (SAY MORE) Sentence:**

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**2<sup>nd</sup> Reason:**

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**Detail (SAY MORE) Sentence:**

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I am going to build \_\_\_\_\_ for the following reasons.

**3<sup>rd</sup> Reason:**

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**Detail (SAY MORE) Sentence:**

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**Closing Sentence:**

For all of the reasons written so far,

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**Detail (SAY MORE) Sentence:**

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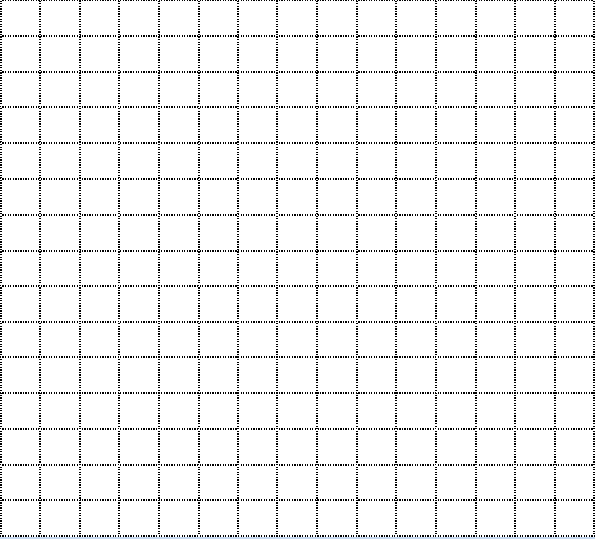
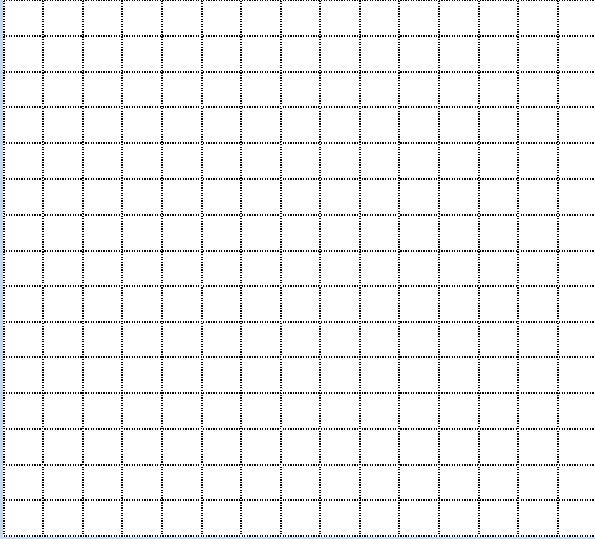
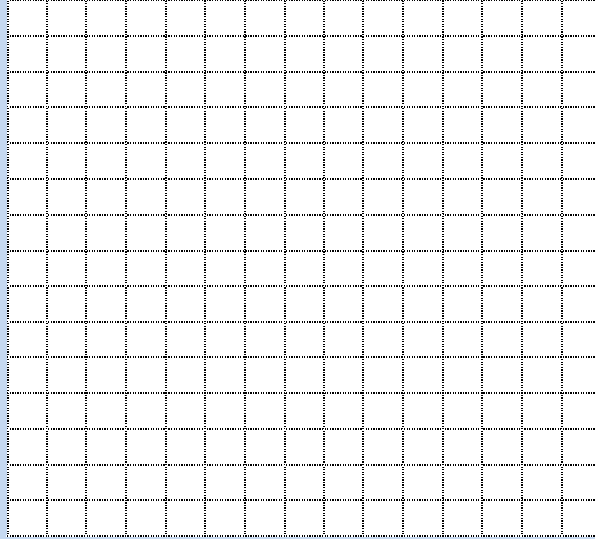
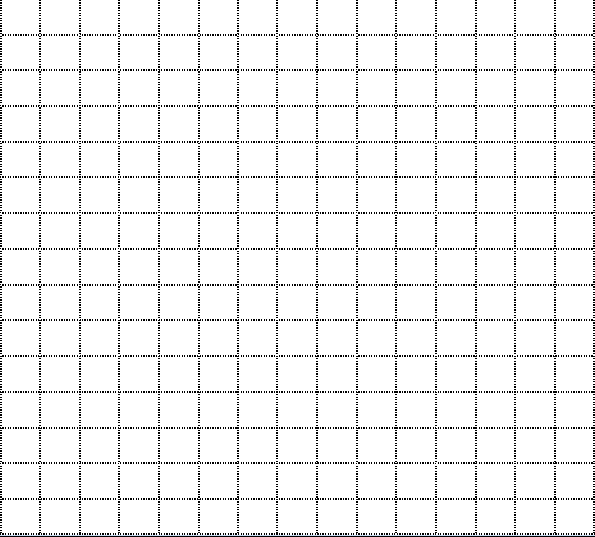
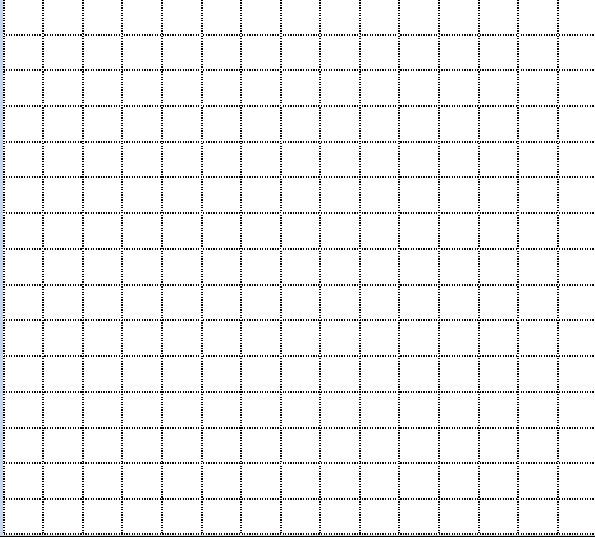
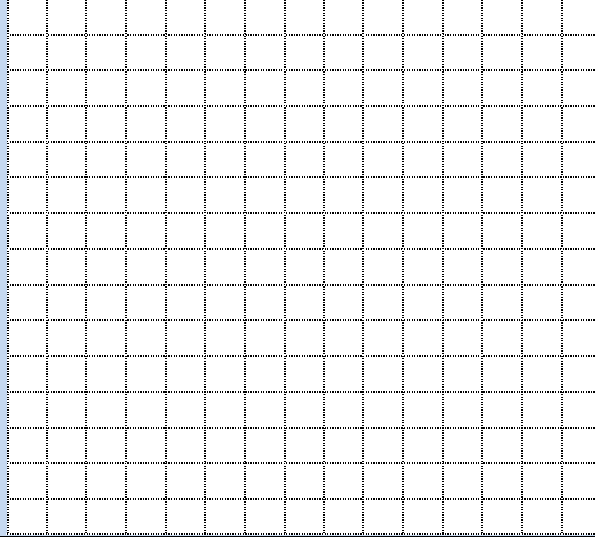
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# Production Drawing

LEFT VIEW	FRONT VIEW	RIGHT VIEW
		
BOTTOM VIEW	BACK VIEW	TOP VIEW
		

**The drawing is highly detailed with the following parts labeled:**

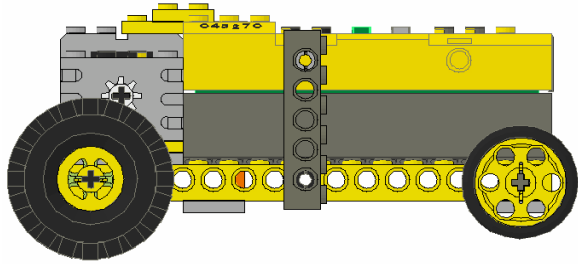
- |     |                                     |                                    |
|-----|-------------------------------------|------------------------------------|
| YES | <input type="checkbox"/> Chassis    | <input type="checkbox"/> Pull cord |
|     | <input type="checkbox"/> Drive axle | <input type="checkbox"/> Mousetrap |
|     | <input type="checkbox"/> Front axle | <input type="checkbox"/> Wheels    |

**The drawing is high quality and the result of painstaking effort with:**

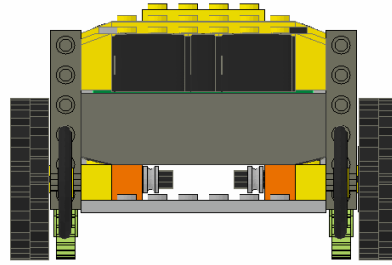
- |     |  |
|-----|--|
| YES | <input type="checkbox"/> No smudges, stray lines or eraser marks                                   |
|     | <input type="checkbox"/> Each view correct and centered in the work space                          |
|     | <input type="checkbox"/> Metric measurements (length, height, width) with correct abbreviations    |
|     | <input type="checkbox"/> Sharp lines drawn with rules, protractors, templates, drawing tools, etc. |
|     | <input type="checkbox"/> Lettering that is neat, legible and correctly spelled                     |



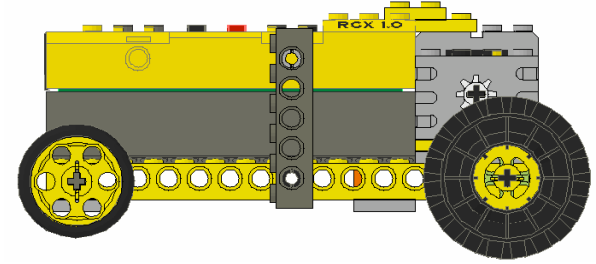
# Example



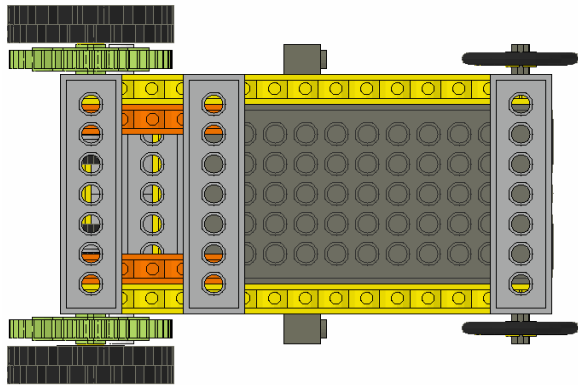
LEFT



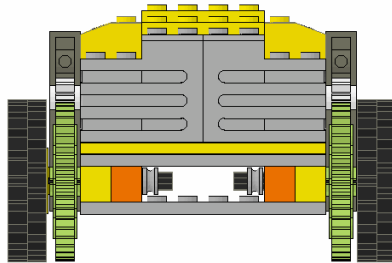
FRONT



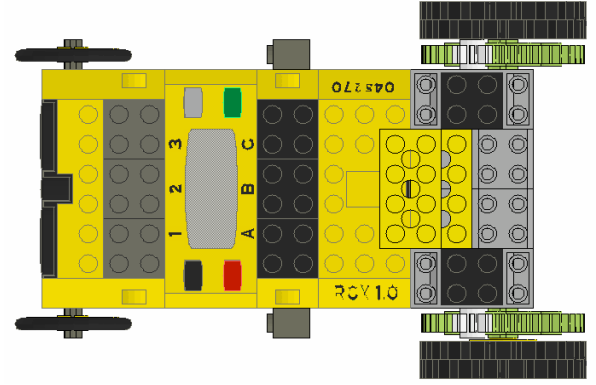
RIGHT



BOTTOM



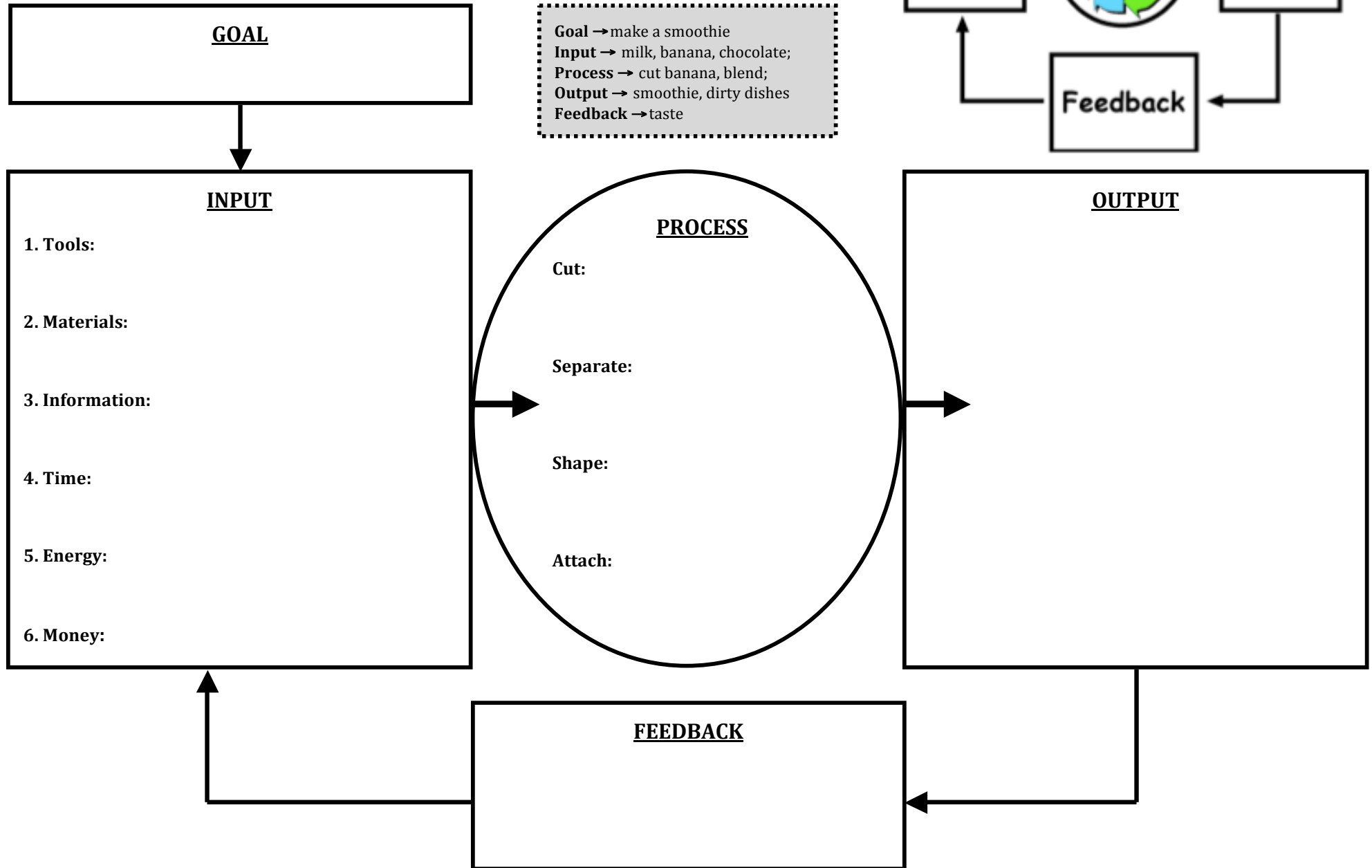
BACK



TOP

- Images courtesy of CEE0, Tufts University

# The Universal Systems Model

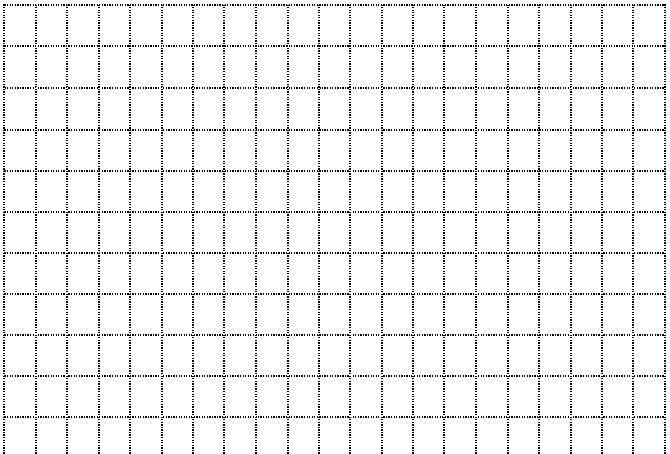


## ENGINEERING DESIGN PROCESS

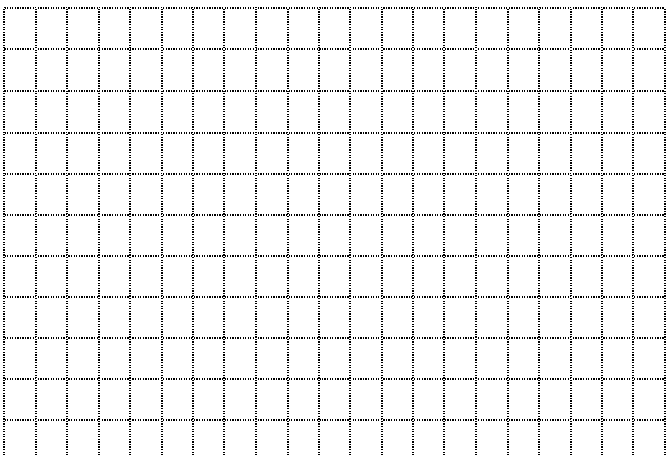
### STEP 5: Build a prototype

Keep a record of how your prototype gets built.  
Complete **ONE** log after each building class.

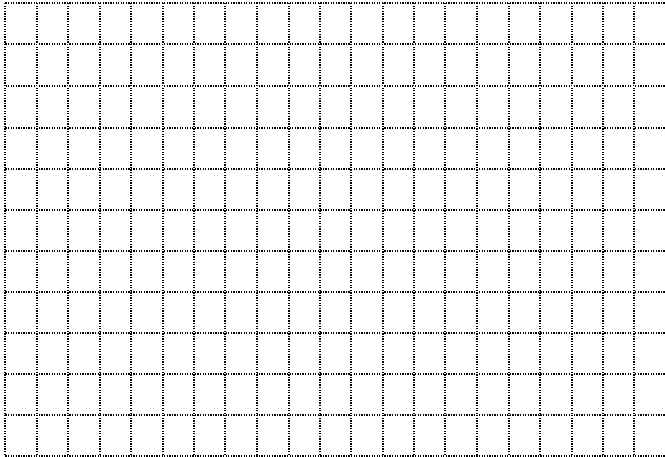
## ENGINEERING LOGS

On the lines below, describe what you did. Mention any difficulties you've had or any design changes you made.	Make a labeled sketch that shows what you did.
<b>LOG #1:</b> <b>Date:</b> _____        	
<input type="checkbox"/> <b>YES</b> I described the drawing in a clear and understandable way <input type="checkbox"/> <b>YES</b> I used key terms and information to accurately describe my progress and drawing. I have enough information. <input type="checkbox"/> <b>YES</b> My description is neatly written and legible.	<input type="checkbox"/> <b>YES</b> My drawing is large enough to show all the details. <input type="checkbox"/> <b>YES</b> My line quality is sharp and precise (no smudges) <input type="checkbox"/> <b>YES</b> My labels are outside the drawing and accurate <input type="checkbox"/> <b>YES</b> My drawing uses shading for highlights

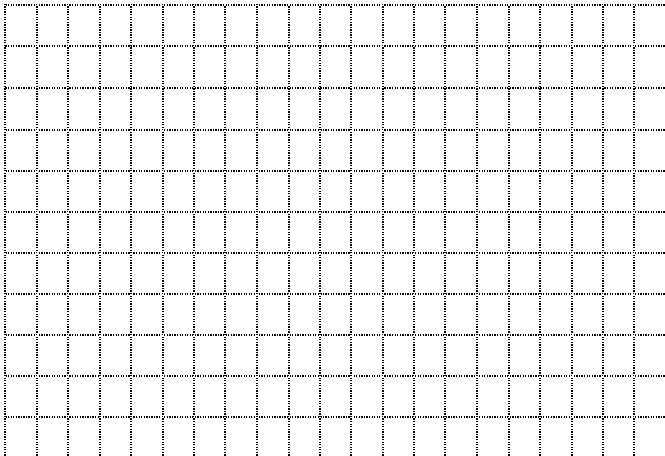
**REMINDER: USE #2 PENCIL ONLY! AND CHECK EACH BOX.**

On the lines below, describe what you did. Mention any difficulties you've had or any design changes you made.	Make a labeled sketch that shows what you did.
<b>LOG #2:</b> <b>Date:</b> _____        	
<input type="checkbox"/> <b>YES</b> I described the drawing in a clear and understandable way <input type="checkbox"/> <b>YES</b> I used key terms and information to accurately describe my progress and drawing. I have enough information. <input type="checkbox"/> <b>YES</b> My description is neatly written and legible.	<input type="checkbox"/> <b>YES</b> My drawing is large enough to show all the details. <input type="checkbox"/> <b>YES</b> My line quality is sharp and precise (no smudges) <input type="checkbox"/> <b>YES</b> My labels are outside the drawing and accurate <input type="checkbox"/> <b>YES</b> My drawing uses shading for highlights

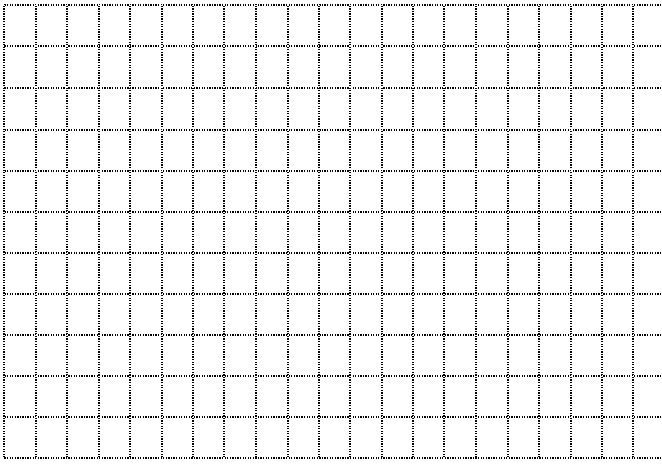
**REMINDER: USE #2 PENCIL ONLY!**

On the lines below, describe what you did. Mention any difficulties you've had or any design changes you made.	Make a labeled sketch that shows what you did.
<p><b>LOG #3:</b>                      <b>Date:</b> _____</p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>	
<input type="checkbox"/> <b>YES</b> I described the drawing in a clear and understandable way <input type="checkbox"/> <b>YES</b> I used key terms and information to accurately describe my progress and drawing. I have enough information. <input type="checkbox"/> <b>YES</b> My description is neatly written and legible.	<input type="checkbox"/> <b>YES</b> My drawing is large enough to show all the details. <input type="checkbox"/> <b>YES</b> My line quality is sharp and precise (no smudges) <input type="checkbox"/> <b>YES</b> My labels are outside the drawing and accurate <input type="checkbox"/> <b>YES</b> My drawing uses shading for highlights

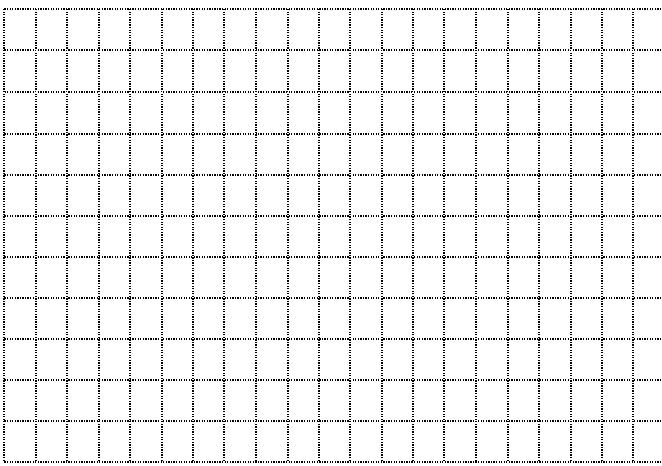
**DID YOU CHECK EACH BOX?**

On the lines below, describe what you did. Mention any difficulties you've had or any design changes you made.	Make a labeled sketch that shows what you did.
<p><b>LOG #4:</b>                      <b>Date:</b> _____</p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>	
<input type="checkbox"/> <b>YES</b> I described the drawing in a clear and understandable way <input type="checkbox"/> <b>YES</b> I used key terms and information to accurately describe my progress and drawing. I have enough information. <input type="checkbox"/> <b>YES</b> My description is neatly written and legible.	<input type="checkbox"/> <b>YES</b> My drawing is large enough to show all the details. <input type="checkbox"/> <b>YES</b> My line quality is sharp and precise (no smudges) <input type="checkbox"/> <b>YES</b> My labels are outside the drawing and accurate <input type="checkbox"/> <b>YES</b> My drawing uses shading for highlights

**REMINDER: USE #2 PENCIL ONLY!**

<p>On the lines below, describe what you did. Mention any difficulties you've had or any design changes you made.</p>	<p>Make a labeled sketch that shows what you did.</p>
<p><b>LOG #5:</b>                      <b>Date:</b> _____</p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>	
<p> <input type="checkbox"/> <b>YES</b> I described the drawing in a clear and understandable way  <input type="checkbox"/> <b>YES</b> I used key terms and information to accurately describe my progress and drawing. I have enough information.  <input type="checkbox"/> <b>YES</b> My description is neatly written and legible.         </p>	<p> <input type="checkbox"/> <b>YES</b> My drawing is large enough to show all the details.  <input type="checkbox"/> <b>YES</b> My line quality is sharp and precise (no smudges)  <input type="checkbox"/> <b>YES</b> My labels are outside the drawing and accurate  <input type="checkbox"/> <b>YES</b> My drawing uses shading for highlights         </p>

**DID YOU CHECK EACH BOX?**

<p>On the lines below, describe what you did. Mention any difficulties you've had or any design changes you made.</p>	<p>Make a labeled sketch that shows what you did.</p>
<p><b>LOG #6:</b>                      <b>Date:</b> _____</p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>	
<p> <input type="checkbox"/> <b>YES</b> I described the drawing in a clear and understandable way  <input type="checkbox"/> <b>YES</b> I used key terms and information to accurately describe my progress and drawing. I have enough information.  <input type="checkbox"/> <b>YES</b> My description is neatly written and legible.         </p>	<p> <input type="checkbox"/> <b>YES</b> My drawing is large enough to show all the details.  <input type="checkbox"/> <b>YES</b> My line quality is sharp and precise (no smudges)  <input type="checkbox"/> <b>YES</b> My labels are outside the drawing and accurate  <input type="checkbox"/> <b>YES</b> My drawing uses shading for highlights         </p>

# ENGINEERING DESIGN PROCESS

## STEP 6: Test and evaluate the solution

Distance/Time Trials						
Trial	Distance (m)	Time (sec.)	Moves forward and straight	Moves forward but curves	Moves backward or sideways	Does not move
1						
2						
3						
4						
5						

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## ENGINEERING DESIGN PROCESS

### STEP 7: Communicate the solution



Describe (complete sentences) what the data tells you about your prototype's performance.

*A successful explanation will have:*

- ☐ A topic sentence that says what you think the data means.
- ☐ Several complete sentences that gives the reader enough information (three reasons) to support your opinion of the data
- ☐ Proper grammar, spelling and punctuation
- ☐ Lettering that is legible and evenly spaced between words and sentences

**1<sup>st</sup> Reason:**

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**Detail (SAY MORE) Sentence:**

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**2<sup>nd</sup> Reason:**

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**Detail (SAY MORE) Sentence:**

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The data shows that \_\_\_\_\_.

**3<sup>rd</sup> Reason:**

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**Detail (SAY MORE) Sentence:**

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**Closing Sentence:**

For all of the reasons written so far,

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**Detail (SAY MORE) Sentence:**

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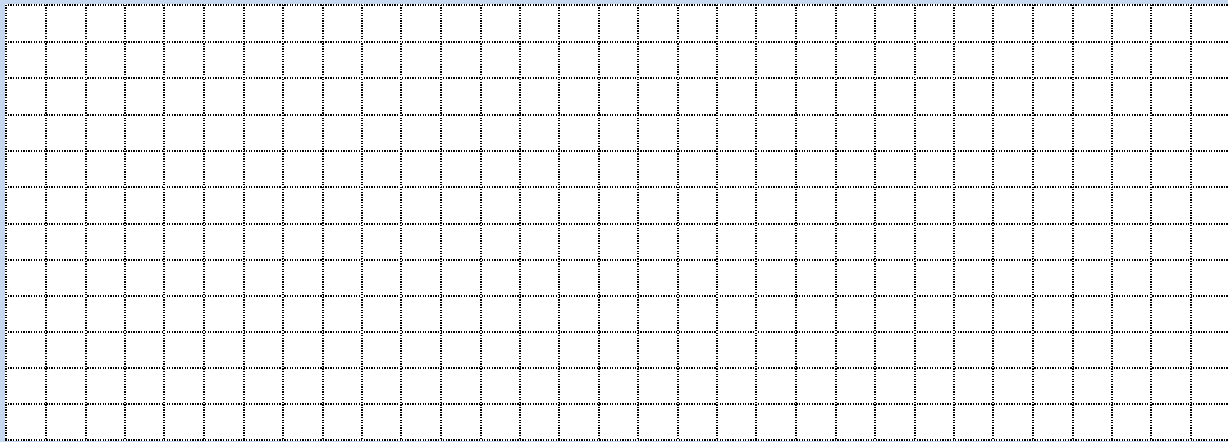
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**ENGINEERING DESIGN PROCESS**  
**STEP 8: Redesign**



Draw a **NEW VERSION** of your prototype that has three new parts or features that are **not** on the one you made.



Describe how each part you added or changed will improve the prototype.

1. \_\_\_\_\_ will improve the prototype by \_\_\_\_\_  
\_\_\_\_\_
2. \_\_\_\_\_ will improve the prototype by \_\_\_\_\_  
\_\_\_\_\_
3. \_\_\_\_\_ will improve the prototype by \_\_\_\_\_  
\_\_\_\_\_

**ENGINEERING DESIGN PROCESS**  
**STEP 9: Make a decision**



On a scale of 1 to 10, how effective was your prototype in meeting the criteria? (Put an X on the line)

X-----X  
1 2 3 4 5 6 7 8 9 10  
Ineffective Somewhat effective Effective Highly Effective

Explain your rating in COMPLETE SENTENCES.

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# Applied Technology Self-evaluation

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Project: \_\_\_\_\_

<b>1. Did you enjoy the project? ____Yes ____No</b>	
Why, or why not?	
<b>2. What do you think would make this project better?</b>	
a. We could spend <i>less</i> time on ...	
b. We could spend <i>more</i> time on ...	
c. We could...	
<b>3. What new skills did you learn in this project?</b>	
<i>(For example, knowing which type of saw to use and how to use it safely, etc.)</i>	
1.	
2.	
3.	
<b>4. What new and interesting ideas did you get from this project?</b>	
<i>(For example, understanding how air bags in cars work)</i>	
1.	
2.	
3.	
<b>5. By doing this project, what did you get better at? Give an example for each one you check as YES.</b>	
a. Working with others? ____Yes ____No <i>Example:</i>	c. Leadership? ____Yes ____No <i>Example:</i>
b. Speaking up? ____Yes ____No <i>Example:</i>	d. Planning a project? ____Yes ____No <i>Example:</i>
<b>6. What have you done to contribute to your success in this class? (For example, I completed all homework)</b>	
<i>Example:</i>	
<b>7. What skills do you think you need to improve?</b>	
<b>Skills</b>  1. 2. 3.	<b>Action(s) I could take</b>
<b>8. Other comments on this project</b>	

Design Brief Rubric					
Name _____		Date _____		Section _____	
Points are earned for completed work that does EXACTLY what is described in each category.					
Category	Criteria	Points	Student Score	Teacher Score	
<b>STEP 1: Identify the Need</b>	▪ I identified which need(s) are met by this prototype's technology and gave specific example(s). [p.3]	5			
<b>STEP 2: Research</b>	▪ I completed the research about this project (p. 4)	5			
<b>STEP 3: Develop Solutions</b>	▪ I have 3 drawings of possible solutions to this design challenge. (p.5)	10			
<b>STEP 4: Select the Best Solution</b>	▪ I filled out the Decision Matrix and explained my reasons for choosing the solution to this design challenge. [p. 6-7]	10			
	▪ I have a detailed and high-quality orthographic production drawing of the prototype I built that is labeled, uses metric measurements and has all the items on the checklist underneath it [p.8]	15			
	▪ I used the Universal System Model to plan and describe the steps stages, materials, people and processes of building my prototype . [p.10]	5			
<b>STEP 5: Build a Prototype</b>	▪ I completed an Engineering Log for each building class during the project. Each entry follows the checklist underneath it.. [p. 11-13]	10			
<b>STEP 6: Testing &amp; Evaluation</b>	▪ I have a data table and graph of the test results [p. 14]	10			
<b>STEP 7: Communicating the Solution</b>	▪ I used test results (data), complete sentences and key terms from p.2 to analyze my prototype's performance. [p.15]	10			
<b>STEP 8: Redesign</b>	▪ I drew a new version of my prototype with 3 improvements and described how each one would make it better. [p.16]	5			
<b>STEP 9: Complete Decision</b>	▪ I evaluated how effective my prototype was and used complete sentences and key terms to clearly communicate the strengths and design flaws that affected my prototype's performance (i.e. choice of materials). [p. 16]	5			
<b>Self-Evaluation</b>	▪ I completed the self-evaluation with specific reasons and examples when asked for. [p. 17]	5			
<b>Mechanics</b>	▪ My design brief is legible, neat and with very few, if any, spelling/grammar errors.	5			
<b>Comments:</b>			<b>TOTAL</b>	%	%

### MOUSETRAP CAR RUBRIC

- ☐ Did you choose and use only approved materials?
- ☐ Did you keep track of and safeguard your materials to prevent loss or damage to them?
- ☐ Did you use your materials effectively?

Tchr. Score	4	3	2	1
<b>MATERIALS</b>	Approved materials were selected, protected and modified in ways that made them even better. <input type="checkbox"/>	Approved materials were selected, protected and used effectively. <input type="checkbox"/>	Approved materials were selected and may be damaged or not used effectively. <input type="checkbox"/>	Approved materials were damaged, not used correctly or randomly chosen. <input type="checkbox"/>

- ☐ Did you use measuring tools, glue and mechanical fasteners to make a sturdy prototype that doesn't break down or need repairs?

Tchr. Score	4	3	2	1
<b>ENGINEERING</b>	The chassis is rigid; axles and mousetrap are straight and securely fastened; the wheels move the vehicle in a straight line without rubbing or wobbling. <input type="checkbox"/>	The chassis is sturdy; axles and mousetrap are securely fastened; the wheels move the vehicle in a straight line with minimal rubbing or wobbling. <input type="checkbox"/>	The chassis is stable; axles and mousetrap may be crooked or not securely fastened; the wheels wobble and rub against the chassis. <input type="checkbox"/>	The chassis is unstable; axles and mousetrap are crooked or not securely fastened; the wheels wobble and rub against the chassis or do not work at all. <input type="checkbox"/>

- ☐ Did you use hand tools and machines (e.g., saws, drills, sanders, hammers, screwdrivers, pliers) safely and appropriately to construct a prototype that looks like a finished product?

- ☐ Did you follow the building plan and does your prototype look like your drawing?

Tchr. Score	4	3	2	1
<b>CONSTRUCTION</b>	The prototype is extremely precise and visually appealing and built according to the production drawing. Corners are square; straight cuts perfectly straight; curves are symmetrical, smooth and consistent. No machine marks, dents, cracks, globs of glue or tape, damaged, jagged or rough surfaces. <input type="checkbox"/>	The prototype looks like a finished product and is built according to the production drawing. Corners are square; straight cuts straight; curves are smooth and consistent. No major machine marks, dents, cracks, globs of glue or tape, damaged, jagged or rough surfaces. <input type="checkbox"/>	The prototype holds together and resembles the production drawings. Some corners are square; straight cuts straight; some curves symmetrical, smooth and consistent. There are some machine marks, dents, cracks, globs of glue or tape, damaged, jagged or rough surfaces. <input type="checkbox"/>	The prototype looks unfinished or like it was thrown together and does not resemble the production drawing. Corners are not square; straight cuts not straight; curves not smooth and symmetrical. There are major machine marks, dents, cracks, globs of glue or tape, damaged, jagged or rough surfaces. <input type="checkbox"/>

- ☐ Was the car ready on time?

- ☐ Did the propulsion system work effectively to move your car at least 3 meters?

Tchr. Score	4	3	2	1
<b>FUNCTIONING</b>	The prototype was completed on time, exceeds all of the project criteria and holds up under repeated use and stress. <input type="checkbox"/>	The prototype was completed on time, meets all of the project criteria and holds up under repeated use and stress. <input type="checkbox"/>	The prototype was ready and meets some criteria but does not hold up under repeated use and stress. <input type="checkbox"/>	The prototype was not completed on-time and/or has fatal design flaws and does not meet criteria or hold up under repeated use and stress <input type="checkbox"/>

### Scoring Key

<b>16-15 pts</b> A+ (98%)	<b>14 pts</b> A (95%)	<b>13 pts</b> A- (90)	<b>12 pts</b> B + (88%)	<b>11pts</b> B (85%)	<b>10 pts</b> B- (80%)
<b>9 pts</b> C+ (78%)	<b>8 pts</b> C (75%)	<b>7pts</b> C- (70%)	<b>6 pts</b> D + (68%)	<b>5 pts</b> D (65%)	<b>4 pts.</b> D- (63-60%)