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| **Course:** Introduction to Engineering |
| **Unit:** Systems and Optimization | **exercise:** System Loops | **Time Frame:** 3 - 5 Hours |
|  | Preparation: *Summary of “to do’s” that the teacher should understand and prepare before bringing this lesson to the classroom.* |
| Teachers will need to ensure that the proper supplies are available for students to build their solutions. **Information**Before starting this exercise, students should have an understanding of material covered in:* Presentation: Systems and Optimization
* Reading: Systems and Optimization

**Materials*** Bicycle as an example. Could be a picture, however it is better to have a physical bike in the classroom.

**Tools*** Drawing materials and/or CAD-based software
* Internet
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|  | Safety: *Summary of safety strategies in the lesson.* |
| Safety strategizes vary from student to student. Ensure your students have the knowledge of basic hand-tools so they do not get harmed. |
|  | Desired Results:  |
| Established Goals: |  | Transfer: |
| *Problem Solving Techniques and Applications Standards:*Teachers should use the STEM Academy Standards Correlation System available in the STEM Connections area of a unit to extract specific standards and insert these standards here.  | *Students will be able to independently use their learning to…** Define the input, process, output and feedback loop;
* Replicate the system to scale with the use of mechanical design software or through orthographic hand drawings.
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| Meaning: |
| Understandings*Students will understand that...** Modeling is an effective technique to represent a complex system.
 | Essential Questions*Students will keep considering...** How the represented system could be represented more accurately.
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| Acquisition OF KNOWLEDGE AND SKILL: |
| *Students will know...** The characteristics of basic and complex systems
* Modeling techniques in which large systems can be represented in a smaller footprint
 | *Students will be skilled at...** Designing and developing a scale model of basic systems;
* Representing complex structures using drawings and computer programs.
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|  | Evidence:  |
| Evaluative Criteria: |  | Assessment Evidence: |
| * Accurate
 | *Performance Task(s):* **System Loops**Students will define the input, process, output and feedback loop of a system in this exercise. |
| * Well prepared
* Well constructed
* Visually appealing
 | *Other Evidence:* * Oral/written presentations
* Scaled models
* Drawings
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|  | Learning Plan: *Summary of Key Learning Events and Instruction* |
| 1. **Set Introduction**

If possible, bring in a bicycle for the students to look at. Explain that there are many different systems associated with the bicycle and ask them to identify some (steering, braking, etc.) The bicycle will also be helpful for the students to refer to while completing the activity.1. **Timeline**

This case study will take three to five classroom days to complete. Students will need to be familiar with the systems model presented in the beginning of this unit. Students will also need CAD skills or orthographic hand drawing skills for this case study. This may add time to the case study as needed to get them the skills needed to complete the drawings. Materials for the models can be of any type, as they do not hinder the progress of the case study. For example, welding stool tubing may be a good way of representing a system. But since these are models, a foam core tube glued up to mock the system would be enough for representation.1. **Group Students**

Divide your students into groups of three. Assign each group a specific system found on a bicycle. Depending on the size of your class you may have some groups working on the same system.1. **Requirements**

Give each group the requirements for the presentation they are to present on the last day of the project as outlined on the web portal under Activity 1.1. **Resources**

Another great resource for your students to use in their research is HowStuffWorks.com.1. **Homework**

The students are expected to do the bulk of their work and research at home. It is their responsibility to decide who in the group is responsible for each part. Some additional guidance in how to efficiently divide up the work will help your students from getting stuck or overwhelmed.1. **Recycle**

Encourage your students not to buy any materials to build their models out of. Rather they should recycle things they find at home.**Progress Monitoring:*** The instructor will need to monitor the classroom, checking student’s work and ensuring students are on task and following directions.
* Ensure students store their projects at the end of class and leave all materials in the room.
* At the end of the activity, post student projects in the room and provide appropriate feedback
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|  | Differentiation: *Summary of Key Differentiation Techniques* |
| Please use this space to insert your differentiation techniques. Depending on the needs of students, various techniques might be needed in a classroom, therefore use the information below and experts in the area needed to design your plan for differentiation.*The ASCD Study Guide for Integrating Differentiated Instruction and Understating by Design: Connecting Content and Kids*by Carol Ann Tomlinson, Jay McTighe*Integrating Differentiated Instruction and Understating by Design: Connecting Content and Kids*by Carol Ann Tomlinson, Jay McTigheISBN-13: 978-1416602842 ISBN-10: 1416602844*Differentiating Reading Instruction*by Laura RobbISBN-13: 9780545022989*A Teacher's Guide to Differentiating Instruction*The Center for Comprehensive School Reform and Improvement |

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|  | career Connections: *Summary of Career Opportunities Associated with this Lesson* |
| Please use this space to insert careers that might be connected to this lesson. This section will need continuous updating as new careers and emerging technologies change the opportunities available in the workforce.Good sources for career connections: **Student****Systems Engineer** Systems engineers specialize in analysis of systems.**Manufacturing** Those in manufacturing will often times construct products.**Product Engineer** Many times product engineers “reverse-engineer” products to find how other types of products are made.Occupational Outlook Handbook<http://www.bls.gov/ooh>The National Career Clusters® Framework<http://www.careertech.org/career-clusters> |
|  | Keywords: *Please Insert Keywords from this Lesson with their Definitions* |
| Please use this space to insert keywords and their definitionsUse resources like [dictionary.com](http://dictionary.reference.com/) to find definitions to your keywords |

LOOP—encircle or repeat.

SYSTEM—a set of connected things or parts forming a complex whole.

PROCESS—a series of actions or steps taken in order to achieve a particular end.