**Student Handout: Reverse Engineering of a Camera**

Center for Innovation in Engineering and Science Education

Stevens Institute of Technology

In this project, you will reverse-engineer a device that contains both electrical and mechanical components and then create a systems diagram for the deconstructed device. You will create reassembly instructions and diagrams to share with other teams. They will attempt to reassemble the device using the instructions you have provided.

The single-use camera is a common product that most of us have used. While they are not complex products or systems, they can used as a vehicle for understanding some of the key concepts of systems and systems engineering. Through class discussion and activities, you will learn about reverse engineering and then have an opportunity to integrate reverse engineering and systems engineering through a challenging hands-on activity and collaborative exchanges with another school.

**Activity 1: Letter of Introduction**

Compose a class letter of introduction to be shared with other participating classes and post to Collaboration Central. Things to include in the letter of introduction include:

* Name of your school, subject, and grade level of your class.
* Location of your school including city, state/province, country, latitude and longitude (so other students can pin-point your location on the map).
* What are your schools strengths? What are your schools weaknesses?
* What technological resources do you have available to you?
* What do you think your school could most contribute to this effort?
* What are your goals and expectations in participating in this collaborative effort?
* What do you wish to learn from this first meeting?
* Any other information that you would like to share about your city, school, and community.

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**Activity 2: Pre-Disassembly**

Before you begin teardown of the device you have been assigned, answer the Pre-Disassembly Questions below. Some of the key systems engineering concepts are explained below. Read the Introduction to Systems Engineering materials and use the glossary to help answer these questions.

**Pre-Disassembly Questions**

**Before you begin teardown of the device answer these questions.**

1. What is Reverse Engineering?
2. Why are products reverse engineered?

1. How is this device a system?

1. Describe input, process, output and feedback aspects.
2. What is the purpose of this product?
3. Estimate how many parts are required to make it.
4. Who is the customer?
5. In addition to the customer who are the other stakeholders?

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**Activity 3: Disassembly**

Work as a team to reverse engineer the device your teacher provided. The ideal team will be made up of 4 members. One person should do the physical disassembly. Most parts snap together, and no tools will be required for disassembly but be careful because many of the parts are delicate. A second team member should create a *Disassembly Procedure Table* that describes the step-by-step process of disassembly. Describe the process in one column and use another column to describe how easy or difficult it was to complete each step. The third member could use a digital camera to record images of individual parts and systems. Later on, add these images to the table. The fourth member should carefully observe the disassembly process so that he/she will be able to lead the process of assembling the camera.

Answer the Disassembly Questions after you have taken the camera apart.

**Disassembly Questions**

1. How do the parts work together to create systems within the device? Describe one of the systems.

1. Think about the engineering of this product. Identify some of the requirements, specifications and constraints that influenced the design, material selection and manufacturing of the product.
2. What kinds of tradeoffs do you think the engineers had to make?
3. Identify at least two lifecycle issues for the product. What parts do you think will be the most difficult to dispose?
4. What kinds of materials were used? Why were these materials selected?
5. What kinds of specialists do you think were involved in the design of this product?

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**Activity 4: Assembly Instructions**

1. After the product has been completely disassembled and catalogued, work as a team to reassemble it as completely as possible.

2. Create a second table that includes the name of each part, function, digital image and re-assembly instructions.

3. Prepare a brief report that compares what you expected to find inside the camera before and what you found during disassembly.

4. Prepare a complete set of reassembly instructions that may include diagrams, images, or any other information that would be essential for another team to reassemble this device.

5. Collaborate with other teams in your class that are also creating reassembly instructions for the same device. Work together to select or refine one complete set of instructions that represents the best efforts of your class.

6. Once your teams have produced the final set of instructions, disassemble the devices again and give the components to your teacher who will give your disassembled device to a different team in your class.

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**Activity 5: Assembly and Collaboration**

Obtain the disassembled components for the other camera -- not the one you previously took apart. Review the reassembly instructions for this camera that have been provided by the other half of your class or your partner school.

Your team should reassemble this product given ONLY the instructions provided.

As a team, discuss the aspects of the directions that are unclear or incorrect. Your teacher will instruct you about providing this feedback to your partner teams.

The project concludes when:

* You successfully assemble the new device based on another school's instructions and
* Your partner teams successfully assemble your device based on the instructions you provided