



LESSON GUIDE

Organizer

Design a device that uses random energy input, and transforms it into useful, ordered movement.

There are many machines that transform energy from one type to another, including:

- Light bulbs: Electricity to light
- Crankshaft: Linear to rotational
- Spring: Potential to kinetic

In this challenge, design a device that turns random mechanical energy input into some form of ordered mechanical movement.

RULES

- The device can be 3D printed in multiple parts that need assembly, but it must be composed entirely of printed parts (no fasteners, bolts, adhesives, etc.)
- A lubricant may be used to facilitate smooth movement.

GUIDING DESIGN QUESTIONS

1. What types of mechanisms can create ordered motion?
 - a. Gravity
 - b. Spring
 - c. Latch
 - d. Ratchet
 - e. Form Fit
 - f. Friction
2. How can these be used to create the device?
3. How can the 3D printing technology test the device and its components? How do you progress from a prototype to final design?

TIPS FOR DESIGNING 3D PRINTED PARTS

1. The minimal wall thickness that can be reliably printed is 0.6 mm. For load bearing parts, wall thickness should be over 1.5 mm and the column diameter should be over 2.5 mm.
2. When designing moving parts that are printed as one piece, leave a clearance of ~0.1-0.3 mm (PolyJet™) or ~0.5 mm (FDM®) between parts.
3. Take into consideration the need for support removal. Determine the crucial structural elements and remove other parts to allow for support removal from the internal parts of the mechanism. Create holes that allow support removal from difficult to reach areas (e.g., between mating parts, between an axel and its sheath, etc.).



LESSON GUIDE: ORGANIZER

4. To reduce friction between moving parts, try to minimize the surface area in contact between parts. You can try and design bearings, but you can also create complex shapes that achieve the same goal.

When using 3D printing to create your parts, their complexity does not affect how much time and money are required to produce them.

5. Print prototypes of your design, test them and improve it accordingly.



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