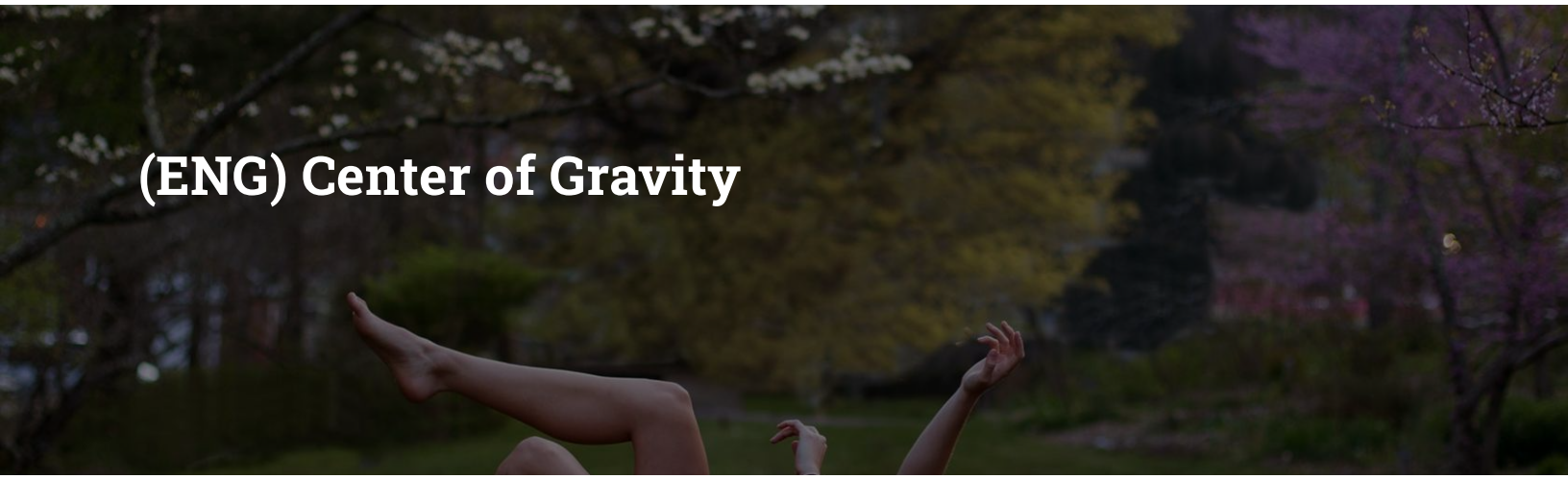

(ENG) Center of Gravity

Introduction

Step 1 - Motivational Stage

Step 2 - Investigational Stage

Step 3 - Consolidation Stage

Introduction

#In-class-activity #Online-activity #Inquiry-based-learning #Experiential-learning #Art-work #Sculpture

The Centre of Gravity is part of our every moment, even if we rarely think about it. For example, when walking, the center of gravity changes all the time. This way the movement usually progresses, and we don't fall at every step.

Objects also have a center of gravity, which can be used to determine, for example, when they are at rest and when they start moving, for example when a ball starts rolling.

There is an interesting special case: a ring. The center of gravity of a ring is in the middle of the empty part of the ring, the hole. What else related to physics must be taken into account when designing a ring?

Learning Objectives

- [ ] Understand and experiment the basic description of the Center of Gravity.

ACTIVITY DETAILS

Activity Details

Connection of the activity with Art

Design of jewelry
Sculpture of Jean Tinguely

Link to local, national School Curriculum

Forces/Center of Gravity

Equipment required

- Paper, Pencils, crayons, or watercolors or
- Molding paste or
- Designing tool in a computer, Printer

Duration of activity

45 minutes

Sources

Photo credit:

Karoliina Havaste. Photo of Sauli Flander with an Oura smart ring, 2022 digital photo
owner: Karoliina Havaste
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Step 1 - Motivational Stage

Ask your students the following questions:

"Where is the center of a ring?"

"How does the design of the ring change it?"

"Do designers need physics in their work?"

Step 2 - Investigational Stage

1

Task 1

Ask the students to read the interview (below) of designer Sauli Flander from Oura Health activity ring company.

THE PHYSICS OF RING DESIGN

Industrial designer Sauli Flander works at the Finnish company Oura Health Oy, which manufactures the smart ring, Oura. "Physics is at the heart of the design of the ring", says Flander.

PRESSURE AND FRICTION IN RING DESIGN

There is a lot of physics involved in designing and shaping the small Oura Ring. The smart ring measures e.g. its user's sleep, activity, heart rate and oxygen saturation. A large part of the things measured by the ring are measured optically, with the help of light. The ring's photodiodes send green, red and infrared light to the finger. Light passes through the blood vessels of the finger and is reflected back to the ring's photodetector, which monitors changes in the amount of reflected light and the mutual ratios of different wavelengths.

An important feature in the design of, for example, a ring or other piece of jewelry is how pleasant it is to wear and wear. Designer Sauli Flander says that this is determined — of course, in addition to the appearance of the product — also by the comfort of use, which is affected by the physical quantities of pressure, friction, and thermal conductivity, for example.

PRESSURE | **FRICTION**

Pressure is defined as the ratio of force to surface area. When using a ring in everyday life — for example, carrying a shopping bag — a force is applied to the ring, which is felt as pressure on the finger. This guides the design of the ring. In the design of the Oura Ring, soft shapes are preferred, Flander says. This means that the forces applied to the ring should be as widely as possible against the skin. If the ring had, for example, sharp shapes, they would exert greater pressure against the skin with the same force, which would be felt as discomfort.

PRESSURE | **FRICTION**

Friction also depends on the surface area: the larger the area the inner surface of the ring touches the finger, the greater the friction between the ring and the finger, Flander tells. Friction is also affected by, for example,

the material used and the surface finish (e.g., matte, or glossy). Friction helps prevent the ring from rotating. If there was too much friction, it would be difficult to put the ring on and take it off.

The center of gravity of the Finnish smart ring Oura lies in the empty space in the middle, says designer Sauli Flander.

The choice of material also affects **thermal conductivity.** The ring may feel cold or warm in the hand due to the material. Some metals conduct heat reasonably well. In this case, the ring feels cold for a moment, but the warmth of the hand quickly equalizes the temperature difference.

The Oura Ring is also a radio device: it transfers the information it measures to a phone via bluetooth. However, the titanium outer shell of the ring blocks the passage of radio waves, as most metals tend to do. Therefore, an accurate understanding of **electromagnetism** is needed in antenna design and placement.

THE CENTER OF GRAVITY IS THE HOLE OF THE RING

Sauli Flander says that different rings also have differences in their center of gravity. For example, in a perfectly round wedding ring made of uniform material, the center of gravity is in an empty spot right in the middle of the hole. In a ring with a large diamond and a thin ring part, the center of gravity can also be significantly higher, close to the diamond.

Flander shows that the Oura Ring is almost round, a few tenths of a millimeter oval and a few tenths of a millimeter thicker at the top than at the bottom. The content density also varies. The densest point is probably the battery, which is located at the top of the ring. Therefore, the center of gravity of the Oura Ring is probably slightly higher than the center of the hole.

HOW MUCH IS PHYSICS INVOLVED IN A DESIGNER'S STUDIES OR WORK?

The university degree programs that train industrial designers do not emphasize physics much.

Flander says that the most important thing for a designer is creativity, a curious nature and teamwork skills. However, in the work of an industrial designer, one inevitably deals with the phenomena of physics when defining the shape, structure, colors or materials of a product. The industrial designer works often also in close cooperation with various engineers: for example, the design of the Oura ring requires e.g. mechanical designers, electronics designers, simulation experts, material scientists and optical designers.

Cooperation with designers is much easier if you are interested in physics and its phenomena. This way you get not only beautiful and usable, but also feasible results.

2

Task 2

Ask the students to design a ring of their own and estimate the Center of Gravity of it.

3

Task 3

Next task is for faster students.

Ask them to study Jean Tinguely's art work and estimate the gravity centers of them. Mobile sculpture of Tinguely is based on the sensitive point of gravity centers.

Jean Tinguely's art work

LINK

Step 3 - Consolidation Stage

Have the students compare their ring designs and estimations of the gravity centres of them.

End of the activity

EXIT