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Der Schlüssel zum globalen Leben,
Digitaler Wandel der Natur



Gesamtdauer: 3-8 Stunden



Student's Age: 12-18 Years



Application Area:

- Energy consumption,
- Kinetic energy,
- Renewable energy,
- Electricity,
- Design.



Keywords: Recycling, DIY, environment, application, coding.



R2 - Pedalkraft -
(Aufladen beim Radfahren)



- Modul
- Erneuerbare Energie
- Globale Erwärmung

R2 – Deutsche Version

Materials:

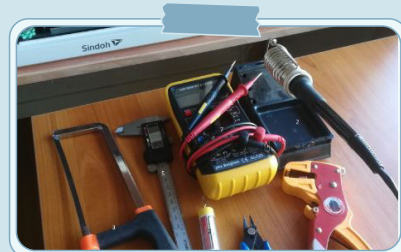
- Old bike with dynamo
- Wood (to build a stand/support for the bike)
- Scrap building materials

Components for the electronic part of a small charger

- 4x generic rectifier diode ([image link](#))
- buck converter ([image link](#))
- bike + dynamo ([type 1](#), [type 2](#))
- usb type A female plug ([image link](#))
- wire ([image link](#))
- proto-board ([image link](#))

Tools

- soldering iron
- nose pliers
- diagonal cutters
- wire stripper
- hookup and speaker wire
- mounting pins
- electrical tape
- zip ties (optional)
- 3d printer and power tools



Notes:

- Take safety precautions when using electronic devices
- Pay attention to the suitability of the dynamos used
- Act in accordance with the learning approach: learning by doing (DIY)



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Introduction

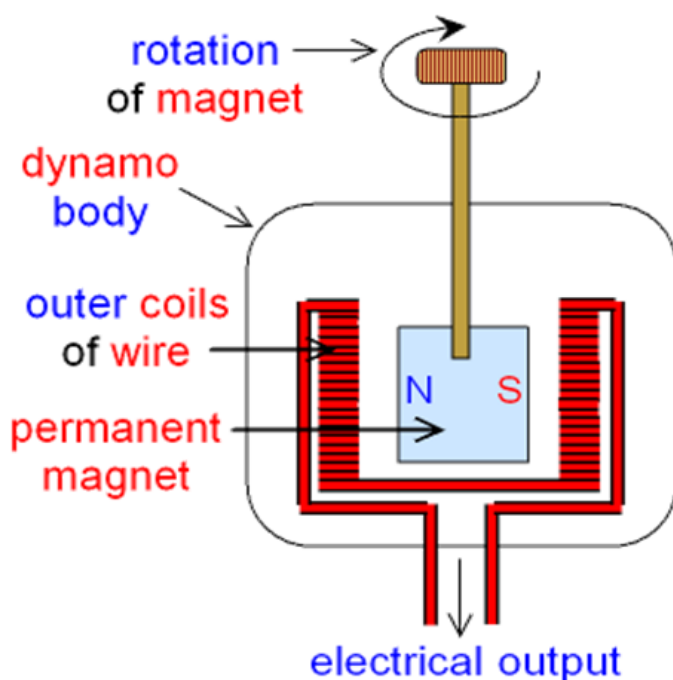
Design and build a straightforward human-powered generator from a used bicycle. Use it as a DIY Bike (Trainer) Pedal Generator to charge a power bank or other small devices. In this STEM challenge the participants will have to think about energy consumption, design considerations and learning how to solder (Picture 1).

Being healthy and active will help you live longer, but finding the motivation to work out? That's hard. Would you be more motivated to cycle if you know that by doing so you have a cheap and easy way to charge your phone, lights, ...? Can you turn human kinetic energy into usable power with a pedal generator? Could you reduce your ecological footprint by charging your bicycle lights, power bank or phone while cycling? This could be your small personal contribution to mitigate climate change.

Why would anyone want to build a pedal generator? To be more environmentally friendly and create a smaller carbon footprint. We can contribute to renewable energy production (Picture 1) by being healthy and exercising. For example, we can charge our phone and simple electrical devices while cycling, because when pedaling we can convert our kinetic energy into electrical energy with the help of a dynamo. This is useful for people who bike to school or to work. Other than charging you can also store the energy you produce, for example in a power bank. This can help the environment in a small way.



Picture 1. Renewable energy production



Picture 2. . General scheme of a dynamo

In a later stadium and if time allows it, the student will research how to improve their design and output voltage using other generators than a dynamo.

A bicycle dynamo is a kind of generator that is attached to bicycles to produce electricity for the bicycle lights.

Bicycles are nowadays not always equipped with a dynamo for the lights, but they are easily available and easy to mount on any bike. A bicycle dynamo is one of the simplest of generators. It also has the advantage that the armature/coil is stationary and the field moves relative to it, in accordance with standard practice in heavy engineering. The field is normally produced by an 8-pole circular magnet rotating between two coils, generating alternating voltages (Picture 2).

Considerations

- Take safety precautions when using electronic devices
- Pay attention to the suitability of the dynamos used
- Act in accordance with the learning approach: learning by doing (DIY)

Aim of the Activity

The students have to build a simple bike trainer generator. They first research different existing types and then make an analysis of what the possibilities are using a simple dynamo. They will first use the output power of a bicycle dynamo to produce a regulated 5V output to charge electronic devices such as a power bank, led-bicycle lights, ... The installation is meant to be used in a fixed place, as for example the bikes.

Students learn: about energy conversion and electricity generation, to solder, to use various tools, and how to 3D print and design a model using electronic information. They understand how energies transform into each other and realize the importance of environmentally friendly projects. Students think about their impact on global warming and gain environmental awareness.

Activity Process

Before Activity

- Student groups are formed.
- Task division is done within each group.
- The necessary materials are provided beforehand.
- Watch the video:

<https://www.youtube.com/watch?v=kVAZIDFMRXY>

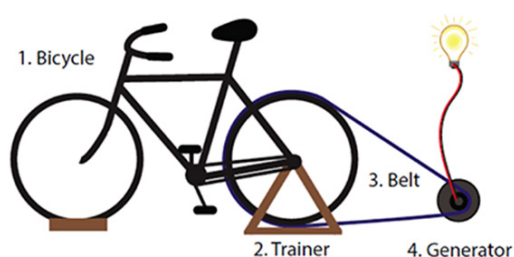


The students research the following questions:

- How does a bicycle dynamo produce electricity?
- Is a bicycle dynamo AC (alternating current) or DC (direct current)?
- How much electricity does a bicycle dynamo produce?
- Who Invented the Bicycle Dynamo?

Let's Start

1 Make it your own



Picture 4. Possible design pedal generator



Picture 3. Bicycle dynamo

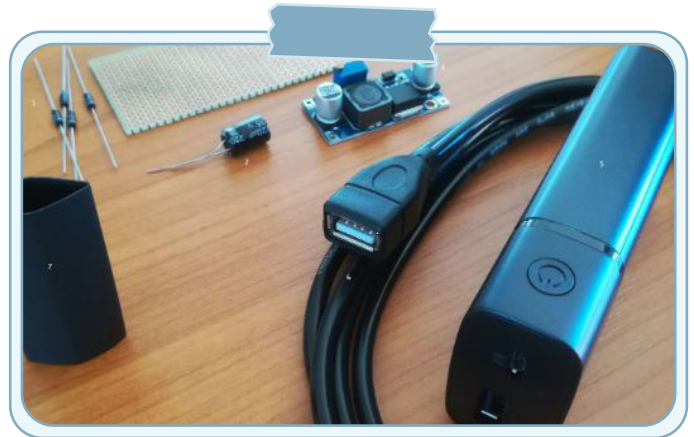
1. Investigate the workings of different pedal generators (Picture 4), there are plenty of manuals on the internet. Get insights in the working of a dynamo. Decide then where and how to place the dynamo to generate electricity.

2. Choose what kind of circuit and electronic parts you are going to need. You can follow this [instructable](#) in case you haven't got other possibilities (Picture 4).

Keep the following in mind when making your choices for the electronic parts.

A simple bicycle dynamo hub usually creates electricity in the form of an alternating current at about 6 volts. Therefore you will have to change the electricity coming out of the dynamo into direct current with the help of a circuit. This is usually done with only a few components, which helps in keeping the weight, size, and cost down. In the following step we give a possible solution.

 [Get much information with this link.](#)

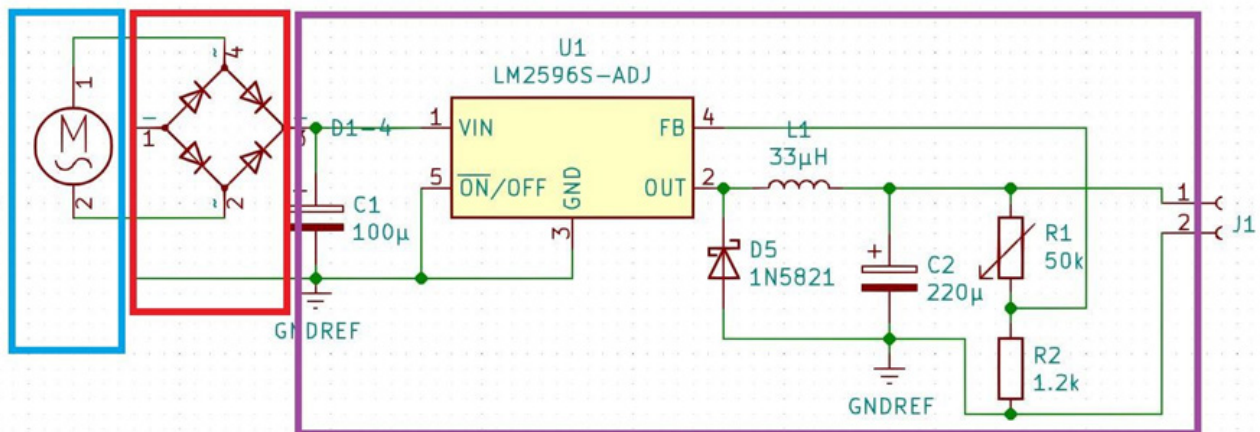


Picture 4. Required tools

3. Collect the necessary electronic parts to create a charger, you can use the electronic circuit suggested below. A short explanation of how the circuit works is as follows.

The alternating current generated from the dynamo is converted into the required direct current (DC) by using a full-wave bridge rectifier having four 1N5822 Diodes. After the conversion, the signal is passed through an electrolytic capacitor for filtering. The filtered signal is sent to a voltage regulator, which will give an output of regulated 5 volts. Before going into the USB socket, the output is filtered one more time by a capacitor to cancel out any residual noise.

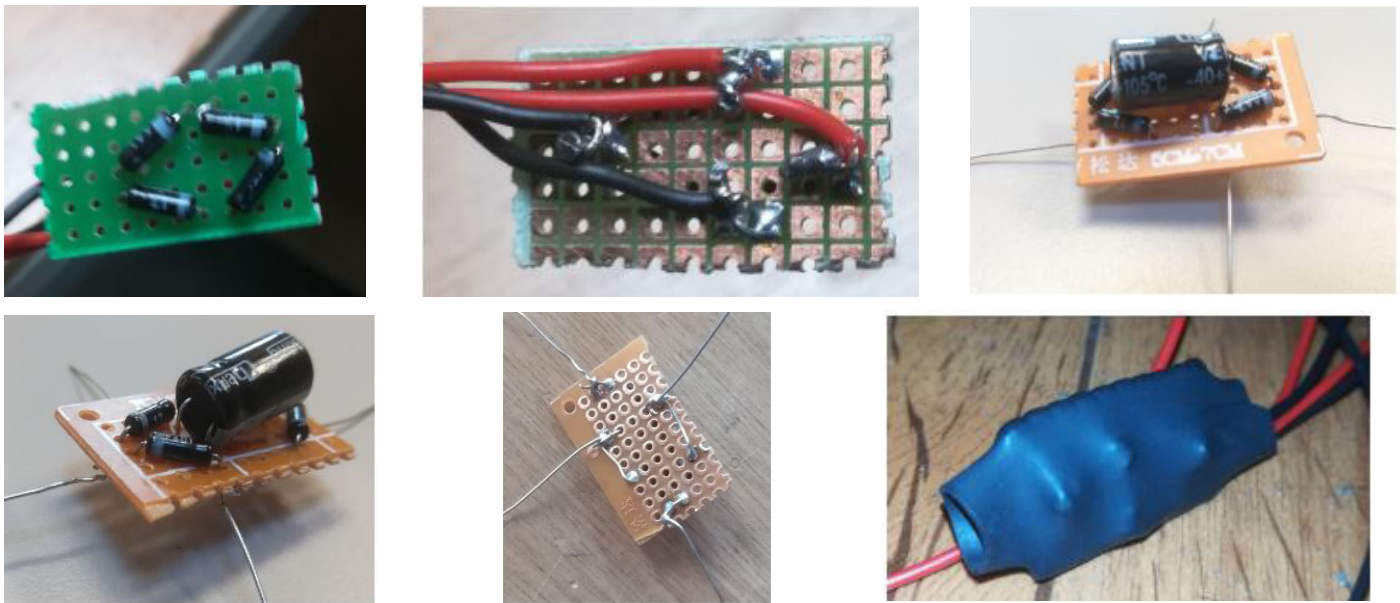
The figure below shows how to connect the different electronic parts to build the charger (Picture 5).



Picture 5. Electronic parts to build the charger.

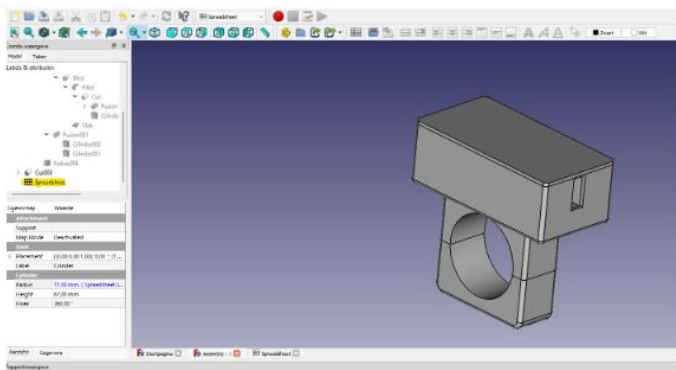


- Cut a piece of the printed circuit board (+- 18x25mm) (Picture 6).
- Fold the legs of the diodes and place them on the circuit board according to the diagram.
- Solder the diodes, pay attention to the polarity! (see the diagram and the picture). Then solder the capacitor and connect to the diodes. Also note the polarity here, consult the diagram.
- Solder cables to the output, and make sure they are long enough.
- Slide the PCB into a piece of heat shrink tubing and shrink.



Picture 6. Electronic parts to build the charger.

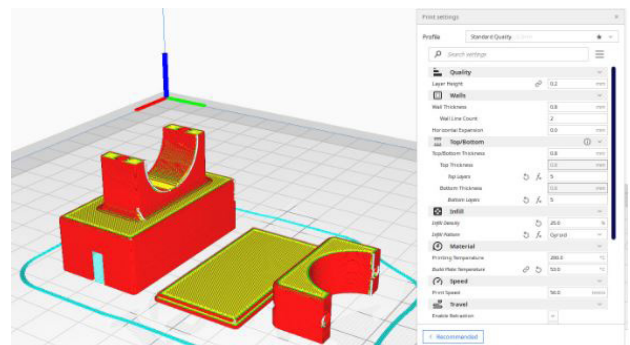
2 Holder for the charger and bike



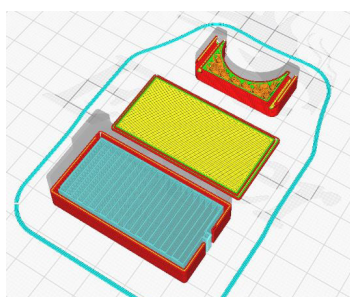
Picture 7. Holder design

1. Design a case/holder for the electronic device & design and make a system to secure it to the bike. The design is up to you. Before beginning construction, draft different possibilities and make it as simple as possible. Take dimensions into account.

2. Design and build a system that allows you to cycle in place. The design of the stand for the bike is completely up to you. A few examples can easily be found on the internet. Just be sure that the stand keeps the bike elevated and secure. If your bike has pegs attached to it, make sure your stand accommodates this and possible other features. Before beginning construction of the stand, be sure to draft a design with appropriate dimensions. A design on paper will save time and prevent mistakes (Picture 8).



Picture 8. Holder design



Picture 9. Holder design

3. The stand should be built so that the rear wheel of the bike is about 10-15 cm off the ground. The dimensions of your stand will be specific to your bike (Picture 9).

3 Reflect and do some math!

1. Measure how much power is being generated while cycling 30 minutes at a slow speed, medium speed, fast speed.
2. Calculate how much power the whole class would generate if each pupil (for example) rides 25km/day for a month. Then multiply this for the whole country, and so on.
3. Write an essay on how the bicycle is a key vehicle to achieve the UN Sustainable Development Goals (SDG 2030), approved in 2015 within the 2030 Agenda for Sustainable Development.

Closure

- At the end of the study, these outputs could be obtained. Here is examples for you



Picture 10. Outputs

Assesment

Evaluation

Students develop and test the model. The developed design is exhibited at the school. The design is peer reviewed and assessed again by the teacher according to the feedback.

Goals	Must be Improved (1)	Medium (2)	Good (3)	Very Good (4)
Cooperation	(....)	(....)	(....)	(....)
Joining discussion	(....)	(....)	(....)	(....)
Following the design- ing steps	(....)	(....)	(....)	(....)
Operability of design	(....)	(....)	(....)	(....)
Sustainability of designing	(....)	(....)	(....)	(....)
Total				

Links

- Inspiring business idea: <https://wewatt.com/>
- https://www.teachengineering.org/lessons/view/cub_environ_lesson03
- Ideas for pedal powered projects: <https://learnmech.com/pedal-powered-bicycle-projects-for-mechanical-engineers/>
- Report on pedal chargers: <https://drive.google.com/file/d/1ffTVBA-fSVtAXbAO3kJWoY5RBewWonDL/view>
- LOW-TECH MAGAZINE (last checked January 2023). How to Build a Practical Household Bike Generator <https://www.lowtechmagazine.com/2022/03/how-to-build-bike-generator.html>
- Instructables (january 2023). How to Build a Bicycle Generator. <https://www.instructables.com/How-To-Build-A-Bicycle-Generator/>
- Createfuture. (2022). The Bicycle Generator. <https://contest.techbriefs.com/2014/entries/machinery-automation-robotics/4676>
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