# Lesson plan - Lesson 1: Introducing the solar kit and garden light.

## Using the MonkMakes solar experimenters kit

## Introduction

This lesson gives you time to introduce the solar experimenters kit to the learners. The particular focus of the lesson is the use of the solar store to develop a device similar in functionality to a solar-powered garden light.

## Learning objectives

* Understand the purpose and functionality of the solar kit
* To be able to label the solar store
* To successfully set up a garden light circuit
* Understand the limitations of a circuit without the micro:bit

## Keywords

Solar store, voltage, super-capacitor, terminals, bulb, harvested, circuit, GPIO

## Preparation

**Subject knowledge:**

This lesson requires no prior knowledge of programming but is an important precursor to the other programming and circuit building lessons as it introduces the solar experimenters kit and the solar store. Initially, building the circuit for the “garden light” is a question of copying a diagram so a practical demonstration of handling the components gently and clipping with alligator clips would suffice.

**Pedagogical approach:**

This lesson uses a combination of practical work in the building of a circuit but also a direct instruction approach in order to ensure that the students are well prepared for the subsequent lessons in the scheme. One of the purposes of this lesson is to provoke curiosity in the students so the question “By looking at the garden light circuit do you know how long the bulb will stay lit when you either unplug the solar panels or if it goes dark?” is intended to encourage them to think about how a micro:bit might be incorporated to make the solar panel and solar store more useful. Notes in the slide deck will remind the teacher of this intention.

**Practical set-up and development environment:**

At this stage the students do not need the micro: bit, just the solar kit with the garden light components.

**Resources that you need:**

* Presentation
* Starter worksheet questions
* Starter worksheet answers
* Experiment worksheet
* Experiment worksheet typical answers
* Plenary worksheet
* Plenary worksheet answers
* Hardware Per pair - 1 solar panel, 1 solar store, 1 lower energy bulb, 1 motor, 1 fan, 5 alligator clip leads

## How the students’ progress is assessed

**Garden light**

The presentation itself begins with a slide showing the labelling of the solar store. The students are presented with a printed version of the solar store and are expected to copy the labels from the board onto their print out. It is interspersed with pair or whole class discussion opportunities. As this is predominantly a practical lesson observing the students’ success in, compiling the circuit will also enable you to assess their progress. The learners also complete a worksheet at the end of the lesson which demonstrates their understanding of key principles conveyed during the lesson.

## Plan (with approximate timings)

| Starter activity 8 mins | **Labelling the data store and answering solar power questions**  The slide that greets the student puts the focus of the lesson in context i.e. it is about how we can store and use the sun’s energy.  The solar store is a component which attaches to the solar panel and, using a battery like device called a supercapacitor, stores the solar energy. This enables the user to use the stored power when they need it.  In addition the students answer some general questions about solar energy. They may be able to answer these from common knowledge or previous physics/geography lessons. |
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| Activity 1 5 mins | **Introducing solar power**  In this section the answers to the starter activities are shared, which put the lesson in context. Depending on time you could also share this (1.5minute) National Geographic youtube video which gives a good visual overview of solar power and solar panels. <https://www.youtube.com/watch?v=NLO9w963Aj0>  If you are using this lesson in the UK this link <https://www.bbc.co.uk/bitesize/topics/zc3g87h/articles/zk9sv9q> also has a very useful 1.5minute BBC Bitesize video which shows an engineer undertaking maintenance on solar panels. |
| Activity 2 3 mins | **Introducing the Monk Makes solar experimenters kit**  Introduce the solar experimenters kit to the students and explain that in this lesson they will be compiling initially one and possibly two circuits to power components with the sun (or electric light). Also explain that in subsequent lessons they will be using the micro:bit to control the flow and recording of energy from the solar store as without the micro:bit the flow of energy to the bulb or fan can be switched off and on by means of a lead only. |
| Activity 3 5 mins | **How does the Monk Makes garden light circuit work?**  Using the slide in the slide deck explain to the students how the light reacts with the photovoltaic cells in the solar panels to produce an electric current. It is also important to emphasise the purpose of the “enable” and “level” connectors to either facilitate the flow of electricity to the device (bulb or later fan) or when disconnected the electricity is not available to the devices but instead continues to build up in the supercapacitor. |
| Activity 4 15 mins | **Students compile the circuit and start experimenting**  Share the slide with instructions on the board to enable the students to build the circuit. Initially they have the switch in the on position so that they can see how long it takes for the lower power bulb to light up. Once it has lit up, get them to experiment with disconnecting the bulb to enable the solar store to build up some charge then cover the solar panel with their hands to block out the light and see whether the bulb still lights up when it is reconnected. The students also complete the experiment worksheet questions worksheet in order to record their results (which are reviewed in activity 6). |
| **Activity 5**  5 mins | **Students adjust the circuit to try out the cooling fan**  Share the slide with instructions on the board to enable the students to build the circuit. |
| **Activity 6**  8 mins | **Review the experiment and prepare for upcoming lessons**  Encourage the students to share the result of their experiments and then very crucially to reflect on what type of things they think the micro:bit might be able to do to make the use of the solar panel more user friendly. The types of things that they might say are:  Measuring charge on supercapacitor  Display on micro:bit  Use of buttons on/off  Use of temperature sensor |
| **Plenary**  6 mins | **Garden light plenary worksheet**  Students complete the plenary worksheet which tests whether they can still label the solar store and answer questions about solar energy. |
| **Homework** | **See if you have any solar powered devices in your home or at school, come back ready to list them.** |

## The Author

This lesson plan and all its parts were created by Dr. Paula Beer of Beer Academic Consultancy in collaboration with Monk Makes Ltd.



Dr Paula Beer has taught Computer Science and IT education to new and established teachers since 2007. Her own research has focused on the use of play and collaboration in computer science. She enjoys supporting practicing teachers by designing accessible lesson planning materials to get students engaged in computer science through play and collaboration. Paula has also produced educational materials for The Raspberry Pi Foundation, been a secondary school teacher, written a successful book (Hello App Inventor!) and has previously worked in IT project management for a media company and for the NHS.