

An introduction to Robotics with LEGO® MINDSTORMS (XIX)

EV3 Science Activity Pack

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The LEGO MINDSTORMS EV3 Education software goes well beyond offering a programming environment for robots and some tools for collecting data in the science area. LEGO Education also offers a series of complements to facilitate the development of the full potential of the system. For now these are the following:

- LEGO MINDSTORMS EV3 Science Activity Pack
- EV3 Design Engineering Projects
- EV3 Space Challenge

Each of these packs are an aid to teachers who work in the STEM environment (Science, Technology, Engineering and Mathematics), a series of activities that can be used as-is or as a starting point to adapt them to the needs of a specific class. The activities in the Space Challenge come with a mat, a number and of models that serve to develop activities and can be an interesting resource for after school activities.

These complements do not include the EV3-G programming software, and in order to be able to

use them you need to have a licence for LEGO MINDSTORMS Education EV3. After installing each pack it will show up as a new option when you open EV3-G as can be seen in the following image.

In this article we will have a look at the characteristics of one of these complements: the Science Activity Pack.

Proposed activities

This pack contains 14 activities related to different areas of physics:

- **Energy:** 5 experiences to study the transformation of mechanical and solar energy into electrical energy, as well as from electrical to mechanical energy.
- **Force and movement:** 5 experiences about the effects of friction and inclined planes, kinematics and the use of gears.
- **Light:** an experiment that analyses the relationship between received light intensity on a specific surface and the distance to the source of that light.

Inicio rápido

Archivo

Robot educador

Ciencias

$E = mc^2$

Energía

Fuerza y movimiento

Luz

Calor y temperatura

Información adicional

Ciencias

Experimento para la lección de ciencias

- **Heat and temperature:** In the three proposed experiences different heat transfer mechanisms are treated, as well as the greenhouse effect and insulation.

Half of these activities require the use of the Renewable Energies set while the others require the temperature sensor.

Just like with the other proposals in the LEGO® MINDSTORMS EV3 Education software, the program can be used in student or teacher mode. In this way, when it is in teacher mode it is possible to adapt the experience to the dynamics of the classroom and then distribute it to the group. I should highlight that the activity guide has a section that can only be accessed in teacher mode, and which includes warnings and advice for the use of the activities.

In addition there is a lot of complementary material:

- **Teachers guide:** this guide links the activities to different of the curriculum. The curriculum refers to that of the United States, (and not to that of e.g. Spain) so the value of these references is very relative.
- **Review questions:** a series of documents in pdf format with tests that correspond to the proposed activities. These documents were created in English and their translation into Spanish leaves much to be desired. In some cases the terminology needs to be

adapted to be usable in Spain. One drawback is that these questionnaires are not in an editable format.

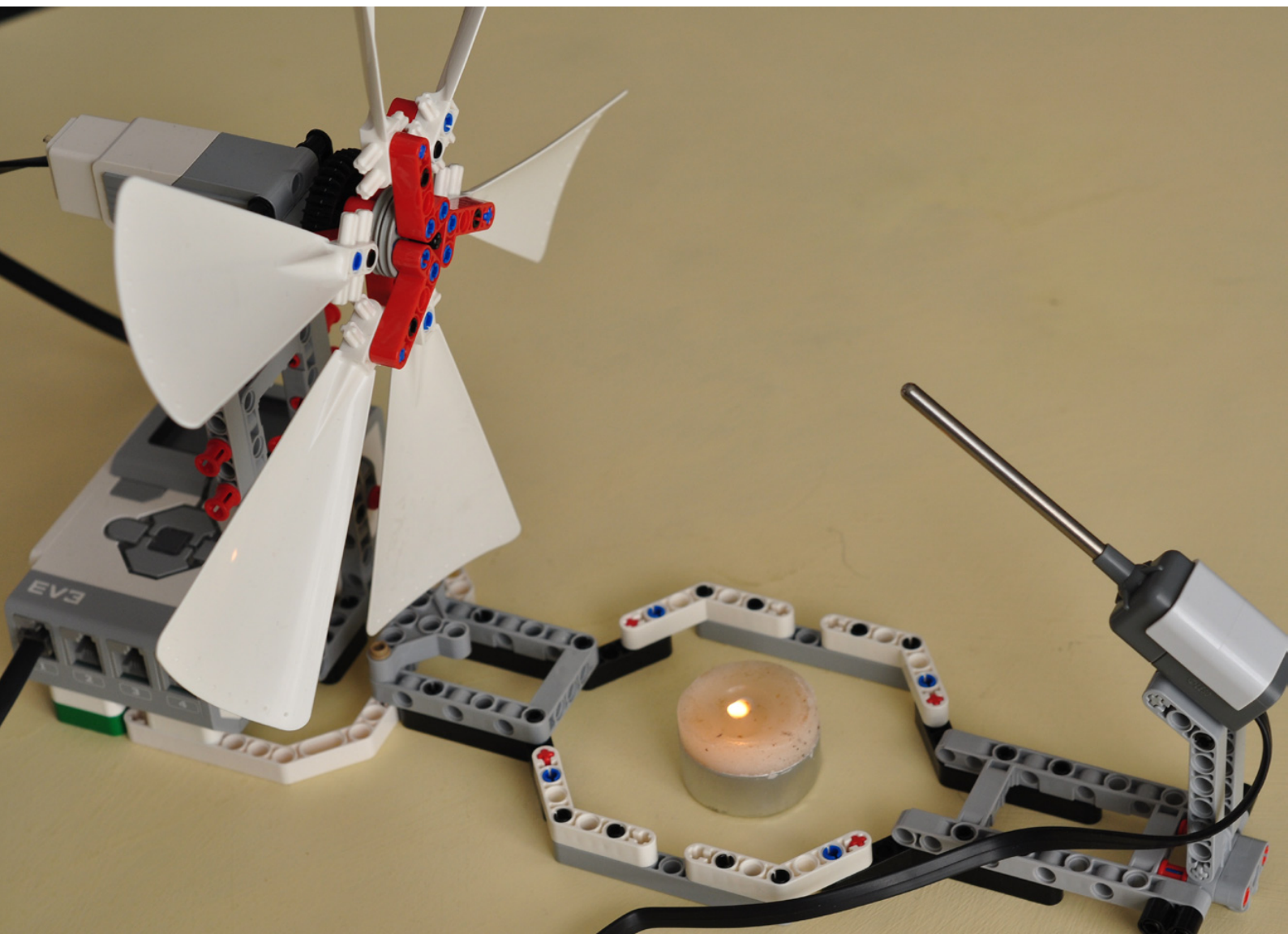
- **Review questions with answers:** the same documents as before, with the correct answers, available for teachers.
- **Building instructions:** the instructions for all the models in pdf format so you can print them.
- **Complementary materials:** 12 text documents in pdf format about electric cars, wind energy, friction... Just like the review questions, the translation and editing of some (though not all) of the documents is deficient. There are some surprising and sometimes inadequate terms, others are unknown and I haven't been able to find them anywhere.

The models

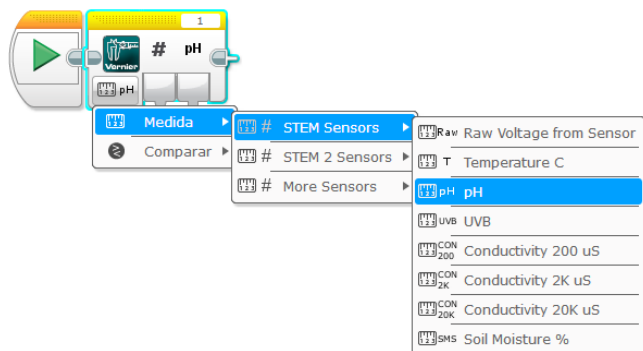
The models are simple and quick to build. This is important, because the objective of these experiences is not the construction techniques, but the fact that serve the purpose of observing and measuring certain natural behaviours. The simpler the better.

The programs

In each case the objective is to gather data that can be measured with the available sensors. This process can be done in different ways and so do these activities.



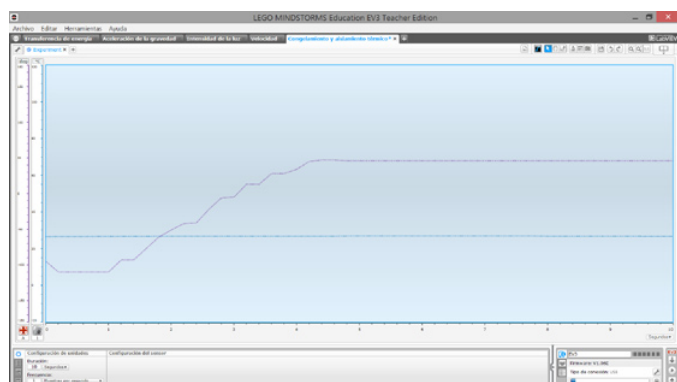
The first way is to present the data on the EV3 screen and then to record them manually. This can be done when the values of the data that is collected don't change constantly, but only when the target is reached. For example, in the study of a free fall in which you need to register the time it takes for a steel ball to fall between two points.



The next method uses the data recording block inside a program. In this case the program registers the data continuously, and this data can then be imported from a computer to analyse the data. As an example the movement of a vehicle is analysed, registering the degrees the motor turns over time.

A third way is using experiment mode instead of the program. This way it is possible to monitor readings from one or more sensors in real time. In addition it is easy to visualise the values and record them with frequency you desire.

In the following image you can see this monitoring in what is called oscilloscope mode.



A matter of interest when reading a program made by someone else is knowing the reasons why things have been done in one way or another. When you access the documentation of the project in teacher mode, the page corresponding to the program contains a link

(<http://goo.gl/t3YXEG>) that takes you to the LEGO® Education page that contains information on how the program was developed. This explanation is available as a PDF file in English. These files come together with a guide to the elements in the renewable energy set and another one with recommendations on light sources that can be used with the solar panel. These recommendations - in English - can be very useful as an inadequate light source can cause a lot of frustration since the solar panel will not respond as expected.

The activity pack has been translated into Spanish and while it is nice to see that all accents have been placed correctly, the use of these accents in the project titles means you cannot download the programs to the EV3 without changing the title of the project.

Evaluation

The activity pack is an interesting tool for science teachers as it offers a number of pre-designed activities about different aspects of science. The license is linked to LEGO MINDSTORMS EV3 Education software so a single copy is sufficient. The teacher mode allows you to adapt the guide to your own needs and even to create a new language version that isn't available (Basque, Catalan, Galician...).

However, using the activities as-is may lead students to simply follow the steps, and I believe it is more interesting to have the students design their own experiments and so have a more significant learning experience.

As far as the areas that are covered, they are limited to those that can be measured using official LEGO MINDSTORMS sensors. There are other compatible sensors on the market designed for this very purpose, mainly those by Vernier (<http://goo.gl/OQF4UR>): pH, conductivity, soil humidity... With these sensors and the working process presented in the pack it is possible to create experiments that encompass numerous other aspects of science.

The pdf complements, including the complementary materials and review questions do not add much to the value of the pack and are in some cases very confusing. I would like to thank ro-botica.com for the license that has allowed me to write this article.

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