

ROLE PLAY GUIDE

FCHgo EPDM Team, October – December 2019

Our language tells us that we imagine forces of nature interacting in chains of processes as being agentive; forces are represented by agents performing their specific tasks while carrying and exchanging energy (see, for instance, M. Deichmann: *Perpetuum Mobile*, 2014).

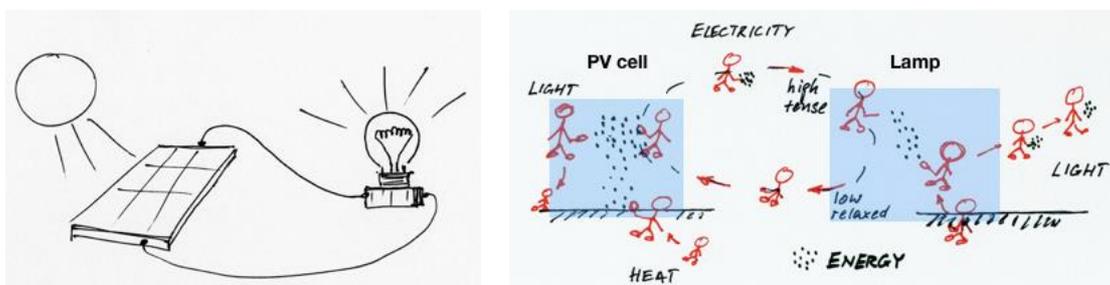


Fig.1: System of PV cells and lamp, and sketch (“story book”) of a play representing processes occurring in this system.

This suggests that agents as representatives of forces of nature can be played by people. As we act out the roles of such agents, we experience physically what, if they were sentient beings, these forces would “experience.” In other words, in our imagination, we can put ourselves in these agents’ shoes. The logic inherent in physical interactions with our bodies will tell us much about how forces of nature act, what they can and cannot do.

Basic idea

Take the example of solar photovoltaic cells used to operate a lamp. The forces at work in this small system are (sun)light, electricity, light (of the lamp), and heat generated both in the cells and in the lamp. A formal process diagram of the system and its processes looks as follows:

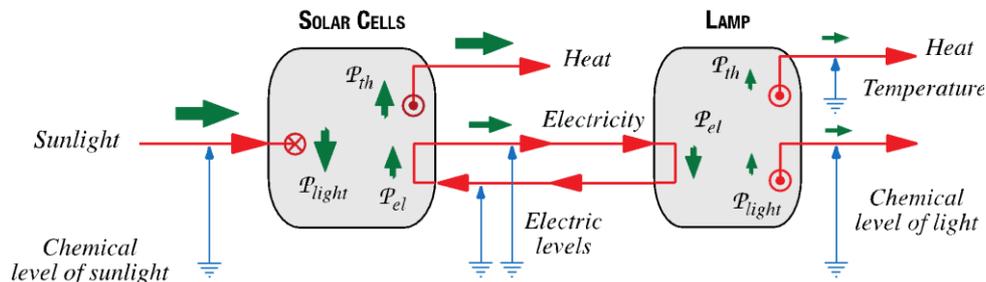


Fig.2: Process diagram of system of PV cells and lamp.

Sunlight flows toward the PV cells; it carries a lot of energy. The light is absorbed (disappears), freeing its energy. The energy made available is used to pump electricity (raise its level or intensity, and make it flow, like water in a water pump). A large fraction of the energy is used to produce heat (an unintended but unavoidable process). Heat and electricity flow out of the cells taking their energy with them.

The electricity that is pumped in the PV cells and flows toward the lamp now flows through the lamp where it falls from the high to the low electric level (it “relaxes”). As a consequence, it makes the energy it carried with it available in the lamp for the production of light and heat (the latter is again unintended). Heat and light are fluidlike quantities that are produced in physical and chemical processes. The energy used to produce light and heat are carried away together with light and heat leaving the lamp. (For more information on process diagrams, see the document *Introduction to FCH technology*).

Design and performance of a role-play

The explanatory narrative presented above as an explanation for the PV cells and lamp system can be transformed into a role-play. Role playing should represent, by means of actors and materials, the processes initiated and undergone by agents and of energy exchange and transfer in a chain of couplers and processes such as in a toy.

Materials needed

“Materials” needed for role-plays of physical systems include children (as many as possible); a space (a “theater stage”) large enough to accommodate the play; ropes and/or colored bands to separate out areas on the floor representing couplers/exchangers and paths between couplers passed over by children representing agents; and confetti (or rice or small gravel; lots of it!); we use confetti to represent amount of energy.

Designating actors (agents/forces of nature)

Children will be divided into groups, each group representing a different force of nature (sunlight, electricity, light, and heat in the example given above, Fig.1 and Fig.2; sunlight, electricity, rotational motion, linear motion, and heat in the example of a solar car, Fig.3 below). Children in different groups may dress differently in order to distinguish between different forces.

Preparatory steps: Creating a first narrative

A system such as a toy needs to be analyzed at the level of elements and forces of nature. Even younger children might be able to come up with a list of couplers in a system (such as PV cells, motor, wheels, lamps, etc.) and forces at work in such a system.

Older students may be able to create a narrative description of the function of the system similar to one explaining the example given in Fig.2. They might be able to identify activities that need to be performed by actors representing a particular force of nature. [To design the role play, every group/force should refer to the story assigned and, possibly, to the *Toy Work Sheets* and process diagrams produced in the previous phase of working on the toy.]

Under the guidance of the teacher (director), actors belonging to a group (to a force of nature) create a “story board” describing their role and activities.

Setting up a play

Areas representing couplers/exchangers are indicated on the floor, and paths between the couplers are laid out.

A bucket full of confetti (or rice or small gravel) is placed at the start of the play area (in our examples, this may be the location of the Sun).

Children playing sunlight go to the bucket with confetti; children representing electricity line up along the return path from the lamp (in the case of the system in Fig.1), the first one just inside the space representing the PV cells; children playing light (of the lamp) may be hidden under a large blanket near the lamp area—remember, light does not exist yet, it will be produced. Children representing heat likewise hide (under a blanket, behind a curtain) near the areas representing PV cells and lamp. All children are in a relaxed state (they have not yet received energy!).

The play should be filmed if possible, so it is necessary to identify the main points upon which the cameraperson will focus. The film will be edited afterwards.

Playing the play

One by one, children representing sunlight pick up a handful of confetti from the bucket, transform into a tensed state (possibly by now standing and walking erect, expressing high tension in their faces or other demeanor; they are now in a positive emotional state) and walk in single file toward the area designated as PV cells. [Sunlight-children should be “created” at the surface of the Sun; whether or not we want to represent this process is not vitally important.]

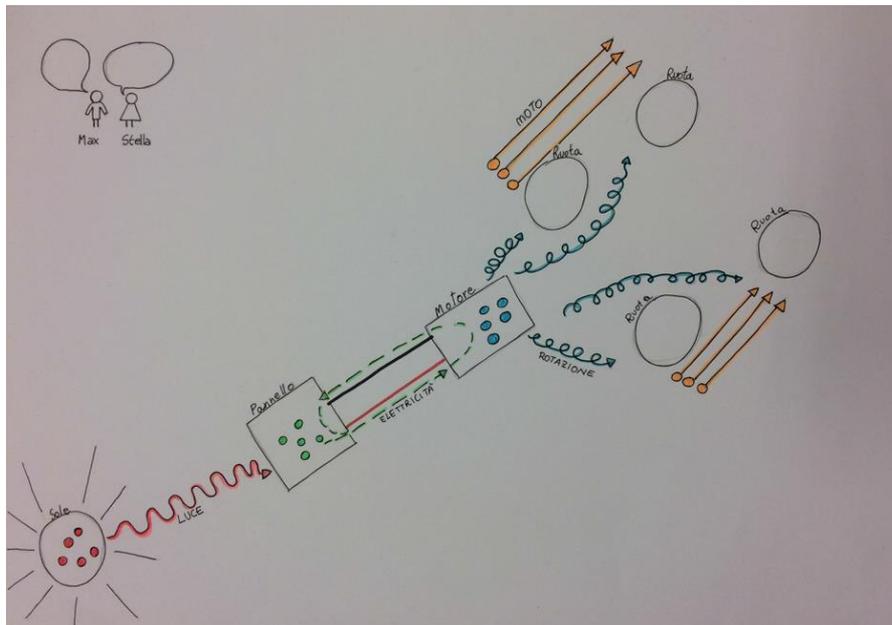


Fig.3. Draft of the scene of a play for a sola car composed of a solar cell, an electric motor and the wheels. The various arrows represent the energy carriers (light, electricity, rotational motion, linear motion) acted by the children (the shapes of arrows are indicative of the bodily demeanor/movement of the children). In every encounter (in the solar cell, in the electric motor and in the wheels) the children hand over confetti which represents energy. The pupils that have confetti are in a positive emotional state, while those that do not have confetti are in a negative emotional state.

The first sunlight-child meets the first electricity-child inside the PV cell area and hands his/her confetti to the electricity child. Some of the confetti will fall on the floor. In the process, the sunlight child relaxes and the electricity child tenses up. The sunlight child “disappears” (sunlight is absorbed and destroyed in the PV cell) whereas the electricity-child walks out of the PV cell area along the path toward the lamp, carrying the confetti it could catch. As the play unfolds, the second sunlight-child meets the second electricity-child, and so on.

The electricity-children (in a positive emotional state after having obtained confetti/energy) walk toward the lamp area. The first electricity-child should be met by a first lamp-light-child (coming from under a blanket or from behind a curtain). Confetti is handed over but some of it falls on the floor. The electricity-child relaxes and walks back along the path toward the PV cell area. The lamp-light-child tenses and walks out of the lamp area carrying the confetti it obtained. The processes of electricity-children meeting lamp-light-children and exchanging confetti continues.

The last point concerns the role of the confetti that lands on the floor inside the coupler/exchanger areas. The confetti/energy is not lost; it is used to produce heat. This can be represented in the play by heat-children that are created (come from under a blanket or behind a curtain) by picking up all the confetti that fell to the floor. They get into a tense state and walk out of the coupler areas with confetti in their hands.



Remarks

A careful design phase helps to ensure a good performance of the role play. We suggest some trial runs of what is happening in each coupler/exchanger.

Debriefing and evaluation

After the performance (and maybe after watching the film), it is important to discuss and analyze the role-play with the participants, focusing on the analogies between the representation and the real toy. This phase is of central importance for the evaluation of the entire activity.

Here are some questions for discussion:

- Which was your role and how did you feel (the physical and emotional “feel” of being an agent representing a particular force of nature)?
- How did the interaction with the other agents proceed?
- Do you think your role corresponded to what it should represent? Did what happened in the play correspond to what happens in the toy?
- Is the role of energy represented by confetti clear to you now? Do you think that things happen differently in the real toy?

It could be useful to compare different instances of the role-play (of different groups but with the same toy) to highlight similarities and differences.