THE LARGE CONTEXT PROBLEM (LCP) APPROACH

An example of contextual teaching in physics

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The LCP Approach

- The LCP approach was originally developed as a response to the discovery that

- ***learning could be well motivated by a context with one unifying central idea capable of capturing the imagination of the students.***

The Context-Content Problem

- **To motivate students to acquire content knowledge we set contexts that attract them. However, students often cannot deal with the questions and the problems that the context generates unless they already have some content knowledge.**

The insertion of LCPs into the HS physics program

- While teaching the conventional senior high school physics program in the late 1970s and early 1980's , I incorporated LCPs into my daily teaching with increasing confidence.

- I began with the frequent insertion of appropriate LCPs for each major topic, namely,

  Kinematics, dynamics, planetary motion, electricity and magnetism, wave motion, and radiation.

Insertion of LCPs into the HS physics program

For mechanics: ;;

- *Physics and the Bionic Man*, *Physics on the Moon*, *Physics and the Dambusters*, *The Story of Force*;

- For gravity and planetary motion

  A Rotating Space Station, *Journey to Mars*, *The Physics of Star Trek*;

- For electricity and magnetism:
- *A Fossil Fuel Power Plant*, *Electricity in the Home*, *The Experiments of Faraday*;

- For radiation and thermal physics:
- *Solar Power in the Pyrenees*, *A Solar House for Northern Latitudes*.

EXAMPLES OF LCPs developed

- **Solar Power in the Pyrenees (1970) Physics on the Moon (1970)**
- **A Rotating Space Station (1978)**
- **A Solar House for Northern Latitudes (1978)**
- **A Fossil Fuel Power Plant; Electricity in the Home, (1981)**
- **Physics and the Bionic Man (1980)**
- **Physics and the Dambusters (1989)**
- **The Experiments of Faraday (2001)**
- **The physics of asteroid collisions (2003)**
- **The Ubiquitous Pendulum (2003)**
- **Calculating the Age of the Earth and the Sun (2004)**
- **Intuitive physics; Thought experiments (200-2005)**
- **Bionics (2004); The Physics of Travelling to Mars (2005)**

Guidelines for Writing LCPs

- **1. Map out a context with <u>one unifying central idea</u> that is deemed important in science *and* is likely to capture the imagination of the student.**

- **2. Provide the student with experiences that can be related to his/her everyday world as well as being simply and effectively explained by scientists' science but at a level that "makes sense" to the student.**

- **3. Invent a "story line" (may be historical) that will dramatize and highlight the main idea. Identify an important event associated with a person or persons and find binary opposites, or conflicting characters or events (Egan, 1986) that may be appropriate to include in the story.**

Guidelines for Writing LCPs…

- **4. Ensure that the major ideas, concepts and problems of the topic are generated by the context naturally; that it will include those the student would learn piece-meal in a conventional textbook approach.**

- **5. Secure the path from romance to precision to generalization (Whitehead, 1929). This is best accomplished by showing the student that:**

- **a. problem situations come out of the context and are intrinsically interesting;**

- **b. that concepts are diversely connected, within the setting of the story as well as with present-day science and technology;**

- **c. there is room for individual extension and generalization of ideas, problems and conclusions.**

Guidelines for Writing LCPs…

- **6. Map out and design the context, ideally in cooperation with students, where you as the teacher assume the role of the research-leader and the student becomes part of an on-going research program.**

- **7. Resolve the conflict that was generated by the context and find connections between the ideas and concepts discussed with the corresponding ones of today.**

Updating the first LCP

- The first successful LCPs were presented to my grade 13 physics class (Ontaio) in the fall of 1970:
- ***Solar Power in the Pyrenees* (1970)**
- ***Physics on the Moon* (1970)**

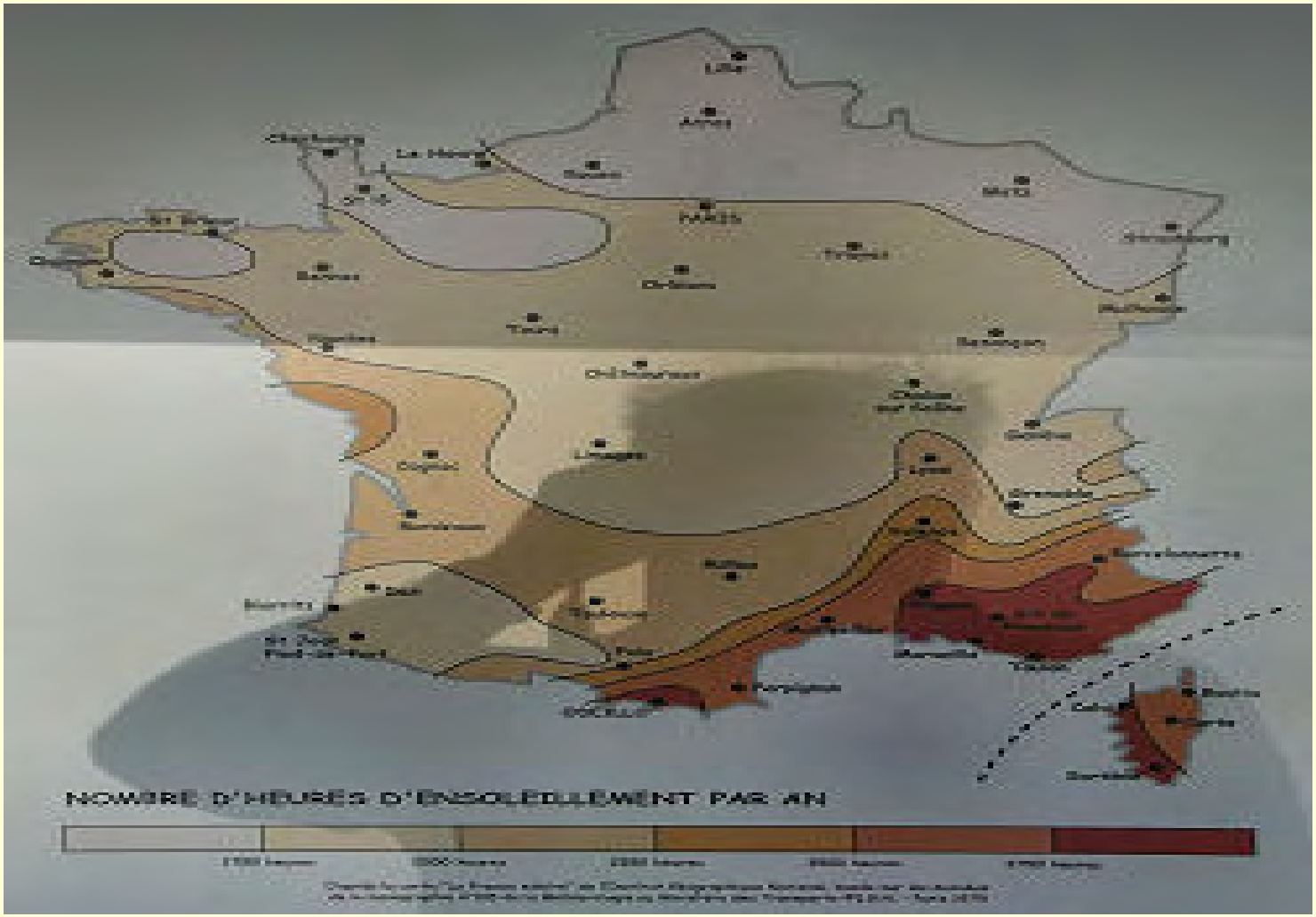
- I will update the first one.

Some details about the solar furnace

- **The solar furnace is located in Odeillo in the Pyrénées Orientales (France) in latitude of 42° 29' 48'' North, and in longitude of 2° 1' 49'' Est and at 1500 meters up. This geographical position guarantees very good weather conditions for this kind of facilities. The total number of sunny hours is 3000h/Year, the hygrometry is very low and the direct solar flux is between 800 w/m2 and 1050 w/m2 for the maximum.**

- **General technical specifications**
- **The parabolic reflector provides at the focal point a maximum flux of 1000 W/cm2. The experimentations takes place at the focal zone (18 m in front of the parabolic mirror The range of available temperature is from 800° to 2500 °C (the maximum reachable temperature is 3800 °C) for a maximum thermal power of 1000 kW.**
- *Details*
-
- **63 heliostats, installed on 8 terraces reflects the sunlight on the parabolic reflector. Every heliostat position is calculated so that the reflected light is parallel to the symmetry axis of the parabolic mirror.**
- *Details*

Sunshine Map of France

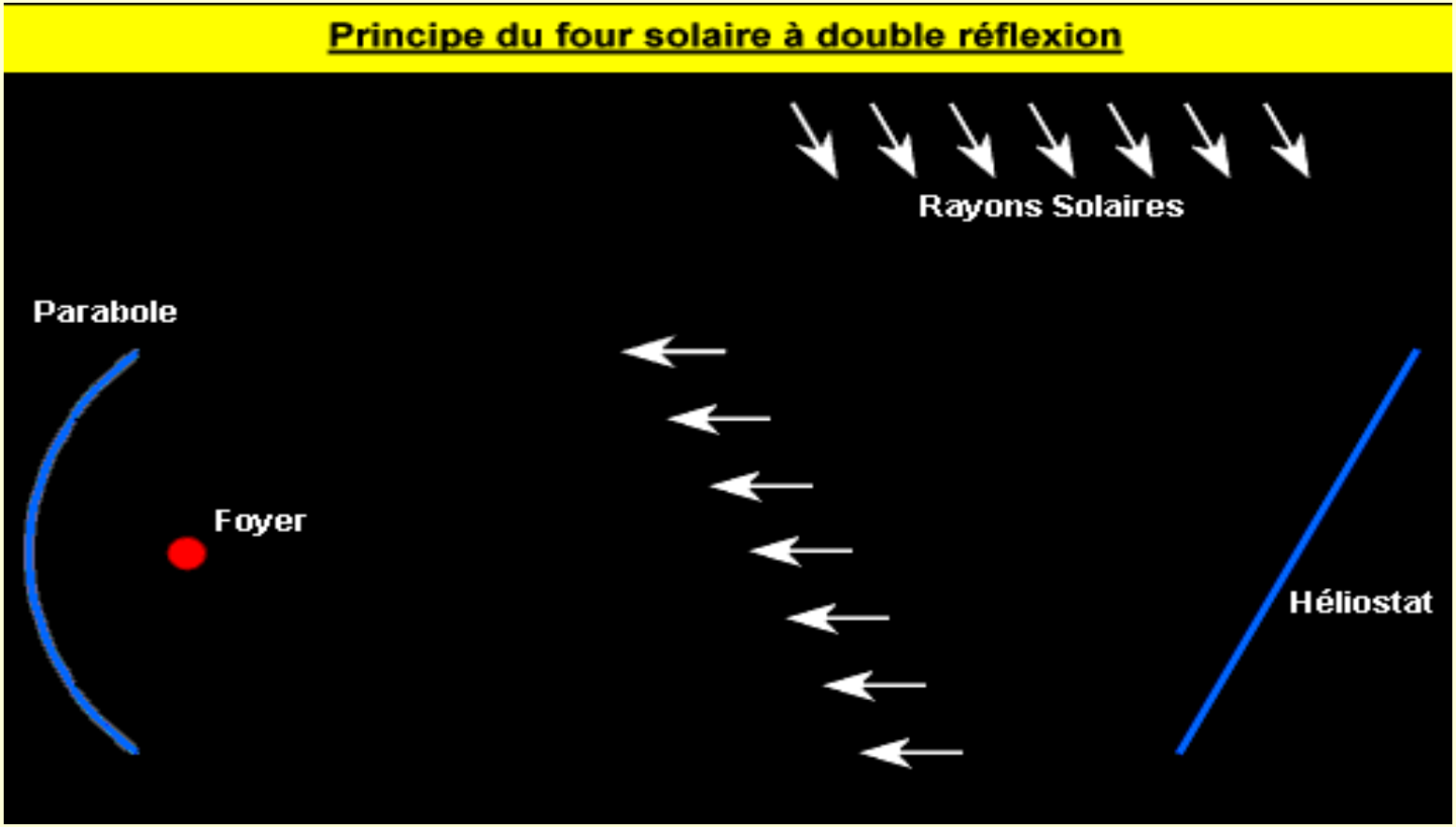


Solar Power in the Pyrenees

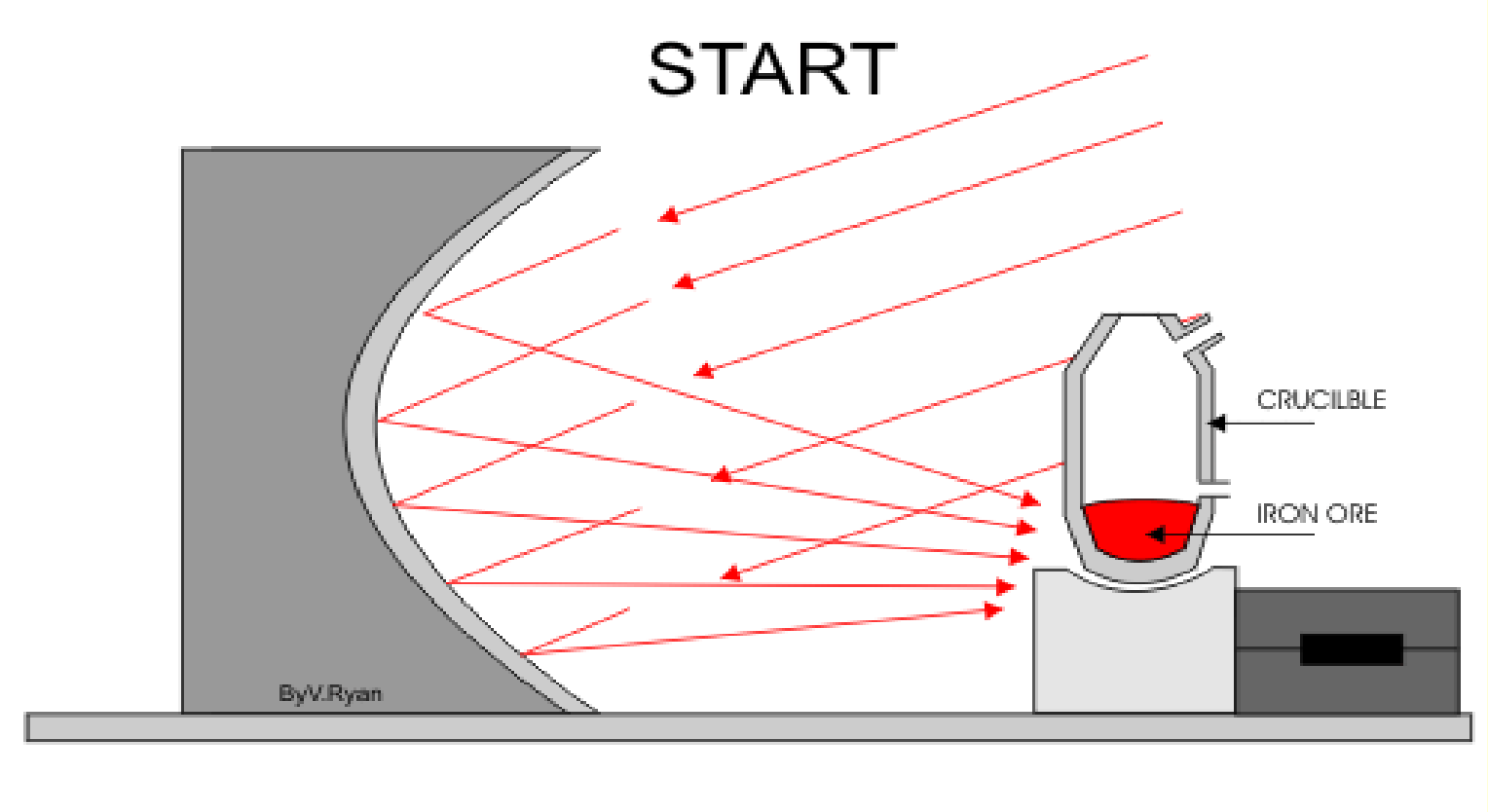
Odeillo Solar Furnace

The mirrors that direct the solar radiation to the parabolic reflector

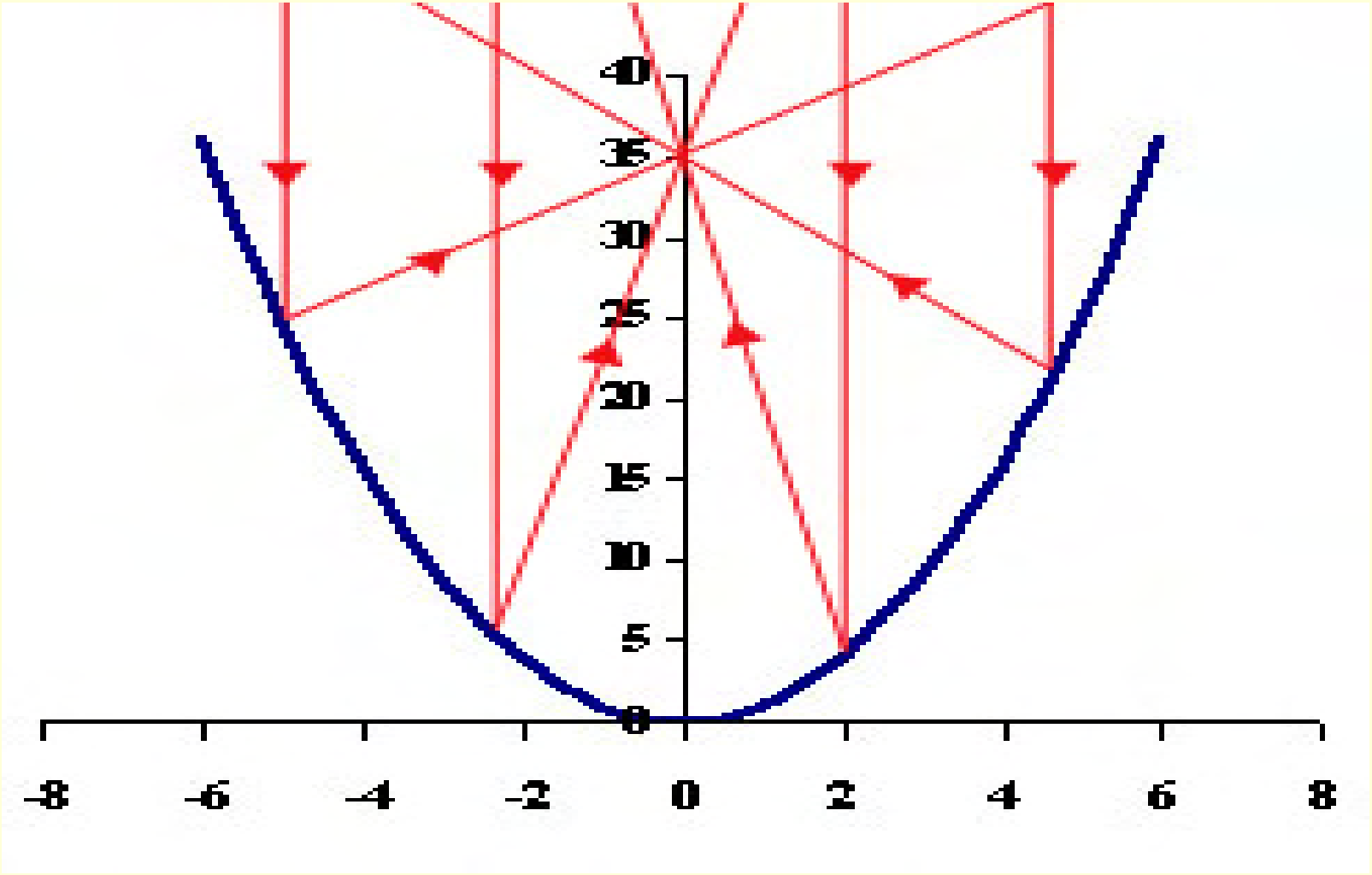
Parabolic Collector



Focusing the Sun's Radiation



Geometry of parabolic reflection



The Focal Point of the Reflector

More technical and scientific detail

- **Solar energy can be stored in the form of heat or in chemical reagents. At the solar furnace of Odeillo, explorations are carried out on the "chemical way" as this seems to be the most promising.**

- The method of storage by chemical cycles consists in producing chemical reactions at a high temperature thanks to concentrated solar energy. The products obtained are capable of storing this energy, permitting its transport and, finally, its release in the form of hydrogen, electricity or heat whenever needed. Other methods are still in the experimental stage, like the cracking of water – the decomposition of water into hydrogen and oxygen under the effect of heat – and the cracking of methane into hydrogen and carbon.

- Other studies focus on the synthesis of nanotubes of carbon with simple walls, an advanced technology of "materials engineering". One hundred thousand times thinner than a hair, two times lighter than aluminium and ten times more resistant than steel, they have a higher electric conductivity than that of copper. Numerous applications are envisaged: combustible batteries, fire-resistant clothing, electricity cables, flat screens, bio-compatible medical sensors, etc. Another direction of research is the resistance of materials in space that are capable of tolerating temperatures of several thousands of degrees. Samples in ceramic composites of several tens of mm in diameter and a few mm in thickness are placed in the furnace to study their behaviour when exposed to the extreme conditions of space .

The Laboratory inside the Building

Solar Two

A small solar cooker

Solar Poer Plant

The 4 Times Square Building

The Area around Odeillo

Country around Odeillo

A field trip to Odeillo?

- **Prices and booking information**
- **Price per week: Low season £200.00 Mid season £245.00**
- **High season £275.00**