Dear Dr. Lederman,

I have reached home, but am not the same. I have been to a mountain-top experience in the Conference on the Teaching of Modern Physics. It is a rare experience for a teacher to be permitted to associate with the recognized leadership of a field, indeed set of fields, and feel no fear of appearing ignorant. On top of that, to be meeting in one of the premier facilities of science compounds the feeling of respect and privilege to be one of those studying physics, and striving to teach the subject.

I love teaching, but need to be fed myself. That is what this session has done for me. I know that my courses will be different, starting tomorrow morning. The details unknown, the general outlines are in place.

- Conference Participant
   April 27, 1986

These words reflect the feeling of 135 high school and college teachers who participated in the Conference on the Teaching of Modern Physics held at Fermilab from April 24 to April 27, 1986. This is the second in a series sponsored by the International Commission on Physics Education (ICPE). The first was held at CERN in 1984. The Fermilab meeting was co-sponsored by the American Association of Physics Teachers (AAPT). The teachers, who hailed from all over the United States and Canada as well as Latin America, spent four days at the Lab in intensive preparation of curriculum materials in particle physics and cosmology. These are the first topics to be tackled in an effort to bring modern physics into the high school and freshman college physics classroom.

The conference was carefully designed and structured to allow a continuous flow of written materials, first into the hands of "editors," then to word processing personnel, and thence directly to the copying machines. This monumental task, successfully accomplished, enabled the participants to return home with an over 170-page manuscript ready to use and test in their classrooms.

Topic lectures were given by leaders in the field (see program listing on page 9). These lectures were designed to serve as course material for the developing curriculum. Following each lecture, participants were divided into five working groups. Each group was led by a high school "master" physics teacher together with a Fermilab physicist. After a short review, each group divided into "color" groups of 3 or 4 people. Each color group was responsible for developing specific
1. "Scatter" by CONDUIT is a computer program that allows the student to "shoot" particles at various targets. Students must then, by viewing the resulting tracks, determine the nature of the target.

2. Particle Formation Game - 2 parts
   
   a. The computer would specify a hadron; students would then be required to "construct" it from the correct quarks. The computer will provide feedback as to the correctness of the response.

   b. Students will assemble quarks and specify resulting quantum numbers. The computer will check for the possible existence of the particle and provide feedback. The computer keeps a record of all student attempts.

3. Interaction of particles

   The computer will "show" two particles interacting. Students will have to determine the resulting particles based on the computer generated tracks of the products (i.e. a computer generated bubble chamber photo.)

   The computer will keep track of all attempts.
2. Construct the following hadrons using $u, d, s, \bar{u}, \bar{d}, \bar{s}$.

<table>
<thead>
<tr>
<th>Particle</th>
<th>Spin</th>
<th>Baryon number</th>
<th>$Q$</th>
<th>$s$ Strangeness</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Xi^+$</td>
<td>-1</td>
<td>+1</td>
<td>+3</td>
<td></td>
</tr>
<tr>
<td>$\Omega$</td>
<td>+1</td>
<td>-1</td>
<td>-3</td>
<td></td>
</tr>
<tr>
<td>$\Lambda^0$</td>
<td>+1</td>
<td>-1</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>$K^-$</td>
<td>0</td>
<td>-1</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>$L^-$</td>
<td>+1</td>
<td>-1</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>$\Xi^0$</td>
<td>+1</td>
<td>0</td>
<td>-2</td>
<td></td>
</tr>
<tr>
<td>$\Xi^+$</td>
<td>+1</td>
<td>+1</td>
<td>-1</td>
<td></td>
</tr>
</tbody>
</table>

Conference on the Teaching of Modern Physics  
Fermilab - April 24-27, 1986

DRAFT -04/26/86
Problems

GUTS

Create a "game" for students

List the properties of constituents and list the operations allowed for elementary particles.

[Ask students to determine all possible results of allowed operations acting on each constituent.]

For this we need to have described for us:

The properties of the constituents

The allowable transformations

The hypothesized mechanisms causing transformations
LAB EXPERIMENT

1. Obtain a rubber sheet from a science supply house.

2. Attach the rubber sheet to an appropriate size wooden frame, snugly attached but not drawn too tightly.

3. To the bottom of the rubber sheet glue a cup hook (plastic). The cup hook will be used to attach weights of different value.

4. Mark the rubber sheet as shown in the accompanying diagram. Add reference circle (centered above cup hook) and Newtonian paths of light.

PART I

1. Use the "Refraction of Particles" launcher from PSSC Physics materials to launch a marble with uniform speed.

2. Without a weight attached to the hook located beneath the rubber sheet, launch a marble along each of the separate lines of flight. Note that the marble follows a straight line path of flight and intersects the reference circle without deflection.

   Note: Experiment with the rubber sheet beforehand to identify 3-5 values of mass that can be attached to produce varying degrees of deformation of the rubber sheet. Values will differ depending upon the strength of the sheet and mass of the launching marble.

3. Attach the smallest weight to the cup hook. Launch the marble along each of the Newtonian paths of flight.

4. Measure the angular deflection of each Relativistic path of flight from the Newtonian path. Record values. Linear deflection can be measured in physical science classes.

PART II

1. Repeat steps 3 & 4, increasing the mass attached to the cup hook up to the maximum "appropriate value".