

Teacher Information section:

TITLE: **“Thinking in Reverse: From Results to Causes”**

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GRADE LEVEL: Regents Physics

NYS STANDARDS: Standard 1, Process skills:

Key idea 3: The observations made while testing proposed explanations, when analyzed using conventional and invented methods, provide new insights into phenomena.

Standard 4, Performance indicators:

V.6: Among other things, mass/energy and charge are conserved at all levels.

V.8: Behaviors and characteristics of matter, from the microscopic to the cosmic levels, are manifestations of its atomic structure. The macroscopic characteristics of matter, such as electrical and optical properties, are the result of microscopic interactions.

Standard 6, Interconnectedness/ Common themes:

Key idea 2: Models are simplified representations of objects, structures, or systems used in analysis, explanation, interpretation, or design.

ABSTRACT: A series of student-performed activities will illustrate to the students the process of collecting indirect evidence to create mental models of unknown/unseen events and phenomena. This process will be related to experimental techniques used in the development of the Standard Model of the atom. Students will use skills such as trial-and-error, data analysis, observation of events, inferences, inductive reasoning, and problem solving while working their way through the sequence of increasingly challenging activities, culminating in the derivation of rules governing a list of actual particle physics interactions.. The activities are intended to help students understand the process of investigating the “invisible” world of sub-atomic particles, and acquaint them with the iterative nature of scientific discovery, which requires that valid scientific laws must behave consistently or be revised, an idea which is fundamental to the development of the Standard Model.

SPECIAL NOTES: This is more of a unit plan than a lesson plan. The Whole lesson contains 11 activities!

TIME REQUIRED: 4-5 class periods

VERSION (DATE): July 19, 2002

MATERIALS:

- 6 dice (big)
- computer w/ internet access
- computer paper
- scissors
- collision carts
- stale cookies
- carbon paper
- masking tape

- 3 similar size steel marbles
- 5/8" foam pipe insulating tube (found at most home improvement stores)
- 2" steel bracket (see illustration)
- 1" storm door thumb screw (see illustration)
- 2 nuts to fit the thumb screw (see illustration)
- 1 small screw eye (see illustration)
- nylon thread (see illustration)
- 1" machine screw w/ nut (see illustration)
- 2 meter sticks
- one large piece of cardboard to cover ramp