**Subject area/course**: Science/Physics

**Grade level/band**: 11-12

**Task source**: Summit Public Schools

**Energy Models**

**TEACHER'S GUIDE**

1. **Task overview**:

In this project, students develop and communicate a conceptual visual model of the conservation of energy for their scientific community.

To achieve this, students will:

* As a group, define what a model is and discuss its purpose.
* Analyze the energy flow through a simple scenario.
* Create a model for the conservation of energy that takes place in a simple scenario.
* Present and explain their scenario and model in an oral presentation to a small group of peers.
1. **Aligned standards:**
2. **Common Core State Standards**

[CCSS.ELA-LITERACY.SL.11-12.1](http://www.corestandards.org/ELA-Literacy/SL/11-12/1/) Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

[CCSS.ELA-LITERACY.SL.11-12.1.B](http://www.corestandards.org/ELA-Literacy/SL/11-12/1/b/) Work with peers to promote civil, democratic discussions and decision-making, set clear goals and deadlines, and establish individual roles as needed.

[CCSS.ELA-LITERACY.RST.11-12.3](http://www.corestandards.org/ELA-Literacy/RST/11-12/3/) Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

1. **Critical abilities**

Analysis of Information: Integrate and synthesize multiple sources of information (e.g., texts, experiments, simulations) presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to address a question, make informed decisions, understand a process, phenomenon, or concept, and solve problems while evaluating the credibility and accuracy of each source and noting any discrepancies among the data.

Experimentation and Evaluation**:** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. Evaluate hypotheses, data, analysis, and conclusions, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

Interpersonal Interaction and Collaboration: Develop a range of interpersonal skills, including the ability to work with others, to participate effectively in a range of conversations and collaborations.

Communication in Many Forms:Use oral and written communication skills to learn, evaluate, and express ideas for a range of tasks, purposes, and audiences. Develop and strengthen writing as needed by planning, revising, editing, and rewriting while considering the audience.

Use of Technology:Present information, findings, and supporting evidence, making strategic use of digital media and visual displays to enhance understanding. Use technology, including the Internet, to research, produce, publish, and update individual or shared products in response to ongoing feedback, including new arguments or information.

Modeling, Design, and Problem Solving:Use quantitative reasoning to solve problems arising in everyday life, society, and the workplace, e.g., to plan a school event or analyze a problem in the community, to solve a design problem or to examine relationships among quantities of interest. Plan solution pathways, monitoring and evaluating progress and changing course if necessary, and find relevant external resources, such as experimental and modeling tools, to solve problems. Interpret and evaluate results in the context of the situation and improve the model or design as needed.

1. **Next Generation Science Standards**

HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.\*

1. **Time/schedule requirements:**

This task will require approximately one week. Time requirements will vary based on grade level, schedule constraints, class size, class length, and academic readiness.

1. **Materials/resources:**
* Item A. What is a Model?
* Item B. Energy Analysis
* Item C. Building the Model
* Item D. Planning Your Presentation
* Item E. Peer Feedback Form
1. **Prior knowledge:**

Students should be familiar with the eight different energy types.

1. **Connection to curriculum:**

None listed.

1. **Teacher instructions:**

There are different ways of representing energy. It is important that teachers emphasize that energy is not the same as matter, so students should all be expected to articulate the idea that a limitation of their models is that they are representing energy physically, but energy itself is not physical.

**Part 1: What is a Model?**

This is a group discussion activity in groups no larger than four. Students can use giant hand held whiteboards or big sheets of butcher paper to record notes large enough to share with the entire class.

The teacher needs to provide some resource for what a scientific model is and/or be explicit about the characteristics of the model (a model represents, explains a phenomenon, and is predictive). References to modeling resources can be found on the tools4teaching science website: <http://www.k12nest.com/content/tools-4-teaching-science> .

The group share out is meant to serve two purposes:

1. Practice sharing out expository information to the class.
2. Give the teacher some idea of where students are with regard to this skill.

If having 6-8 groups present incredibly similar information to the class is too repetitive you could easily have them just partner up with one other group. The practice session here is meant to push students’ ideas of what forms models can take.

**Part 2: Energy Analysis**

Students should already be familiar with the eight different energy types, but a warm up reminder here would not be misplaced.

Essential Elements of Conservation of Energy that need to show up in the model:

1. Energy transfers from one object to another.
2. Energy transforms from one type to another.
3. The total amount of energy in the system stays the same. (This is the tricky bit!)

This step is essential so students understand exactly what it is they are modeling. They are not modeling the scenario; they are modeling the energy flow that takes place in the scenario.

**Part 3: Building Your Model**

**Part 4: Preparing the Presentation**

You may want to split the class into three (or so) presentation groups so one third of the students are presenting their model to 2-3 other students at a time. Those students give comments/feedback (structured with help). Then audience members rotate and the same third present again to a new group. The teacher also rotates during this time.

1. **Student support:**

None listed.

1. **Extensions or variations:**

None listed.

1. **Scoring:**

Student work can be scored using the Summit Public Schools Energy Models rubric.