Down For The Count - Rumford, That Is

Jeff Morgan
University of Northern Iowa
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Jeff Morgan
UNI Physics Department
April 1, 2022
Count Rumford (aka Benjamin Thomson)

Rumford wrote "An Experimental Enquiry Concerning the Source of the Heat which is Excited by Friction" (1798), and argued that heat was not the caloric.

Rumford had observed the frictional heat generated by boring cannon at the arsenal in Munich. Rumford immersed a cannon barrel in water and arranged for a specially blunted boring tool. He showed that the water could be boiled within roughly two and a half hours and that the supply of frictional heat was seemingly inexhaustible.
PRISMS Plus

**PRISMS PLUS** is an internationally-recognized high school physics curriculum developed by professors in the Physics and Science Education departments at UNI.

PRISMS PLUS for students provides 44 complete learning cycles in four units. Each learning cycle includes original laboratory activities for exploration, concept development, and application plus the concept enhancer and conceptual practice support materials students need to complete their understanding.
Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and the speed of an object. [Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and the mass and speed of objects. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a wiffle ball.] Students who demonstrate understanding can:

MS-PS3-1.

Develop a model to describe that when energy is stored in a system, work is done on the system, or the system exchange heat or work with its surroundings. [Clarification Statement: Emphasis is on calculations of potential energy. Examples could include energy storage in a spring or a roller coaster at various points in its path. The wording of models could include representations of energy storage or transformations between different forms of energy.] Assessment is limited to two objects.

MS-PS3-2.

Apply scientific principles to design a device that transforms energy or electrical energy. [Clarification Statement: Emphasis is on the meaning of mathematical expressions used in the model. Assessment is limited to basic algebraic expressions or computations; for systems of two or three components; and to internal energy, kinetic energy, and work.] Students who demonstrate understanding can:

HS-PS3-2.

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. [Clarification Statement: Emphasis is on understanding the meaning of mathematical expressions used in the model. Assessment is limited to basic algebraic expressions or computations; for systems of two or three components; and to internal energy, kinetic energy, and work.] Students who demonstrate understanding can:

HS-PS3-2.

Plan an investigation to determine change in the average kinetic energy of particles in different states of matter. [Clarification Statement: Emphasis is on how measurements are made. Examples of experiments could include comparing a given volume of water with the same mass as it cools or is heated; comparing the energy stored in objects of different masses at the same temperature; or comparing the energy stored in objects of different shapes and sizes at the same temperature.] Assessment is limited to two objects.

MS-PS3-3.

Design, build, and refine a device that works within given constraints to convert and form energy into another form of energy. [Clarification Statement: Emphasis is on both qualitative and quantitative evaluations of devices. Examples could include wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of renewable energy forms and efficiency; Assessment Boundary: Assessment is limited to total output for a given input.] Assessment is limited to devices constructed with materials provided to students.

HS-PS3-4.

Conduct and evaluate an experiment to determine temperature changes that occur when different materials are heated or cooled. [Clarification Statement: Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the changes in energy and temperature of objects at different initial temperatures or during heating or cooling.] Assessment is limited to systems containing two objects.

MS-PS3-5.

Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the change in energy of the objects due to the interaction. [Clarification Statement: Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the changes in energy and temperature of objects at different initial temperatures or during heating or cooling.] Assessment is limited to systems containing two objects.
Learning Cycle Format

**Exploration**
No Flame, No Gain

**Concept Developer**
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**Application**
Heat from Electricity

**Concept Enhancer**

**Conceptual Practice**
Interested in More?

**Mechanics in Physics Education**  
*Even summers*

- 1 week of on-campus lab experience from PRISMS Plus and Modeling Instruction
- 3 weeks of online meetings focused on pedagogy and implementation

**Electricity & Magnetism in Physics Education**  
*Odd summers*

- 1 week of on-campus lab experience from PRISMS Plus and Modeling Instruction
- 3 weeks of online meetings focused on pedagogy and implementation

lawrence.escalada@uni.edu  
jeff.morgan@uni.edu