4-1-2022

Down For The Count - Rumford, That Is

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Recommended Citation

Morgan, Jeff, "Down For The Count - Rumford, That Is" (2022). *Science Education Update Conference Documents*. 28.
https://scholarworks.uni.edu/sciedconf_documents/28

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April 1, 2022

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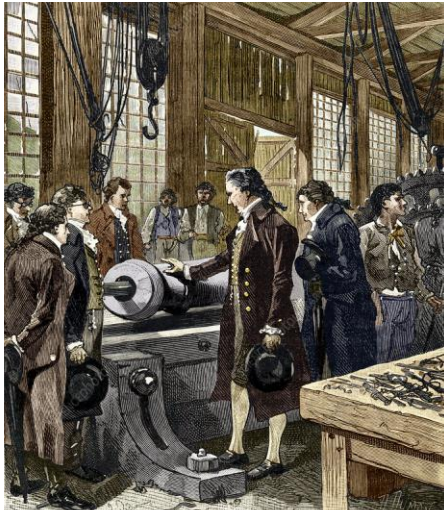
Count Rumford (aka Benjamin Thomson)

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.

Unit 1 FORCE AND MOTION

1 Kinematics

2 Making tracks

3 Accelerating Tracks

4 Vector Vector, What’s My Vector?

5 Relative Motion 6 Static Equilibrium

7 Inertia

8 Newton’s Second Law

9 Using Graphs to Understand Newton’s Second Law

10 Weight

11 Newton’s Third Law

12 Impulse and Change in Linear Momentum

13 Conservation of Linear Momentum

14 Projectile Motion

UNIT 2 WORK AND ENERGY

1 Work

2 Power

3 Conservation of Energy

4 Heat and Temperature

5 Change of Phase

6 Mechanical Equivalent of Heat

7 Ideal Gas Laws

8 Solar Energy

UNIT 3 WAVES AND OPTICS

1 Incandescence or Luminescence?

2 Inverse Square

3 Velocity, Frequency and Wavelength

4 Speed of Sound

5 Factors Affecting Frequency

6 Reflection

7 Refraction

8 Lenses

9 Image Size and Location

10 Diffraction and Interference

11 Color

12 Polarized Light

UNIT 4 ELECTRICITY, MAGNETISM, AND MODERN PHYSICS

1 Electrostatics

2 Electric Fields

3 Magnetic Fields

4 Electric Circuits

5 Ohm’s Law

6 Capacitors

7 Motors

8 Generator

9 Radioactive Decay

10 Spectra and Energy

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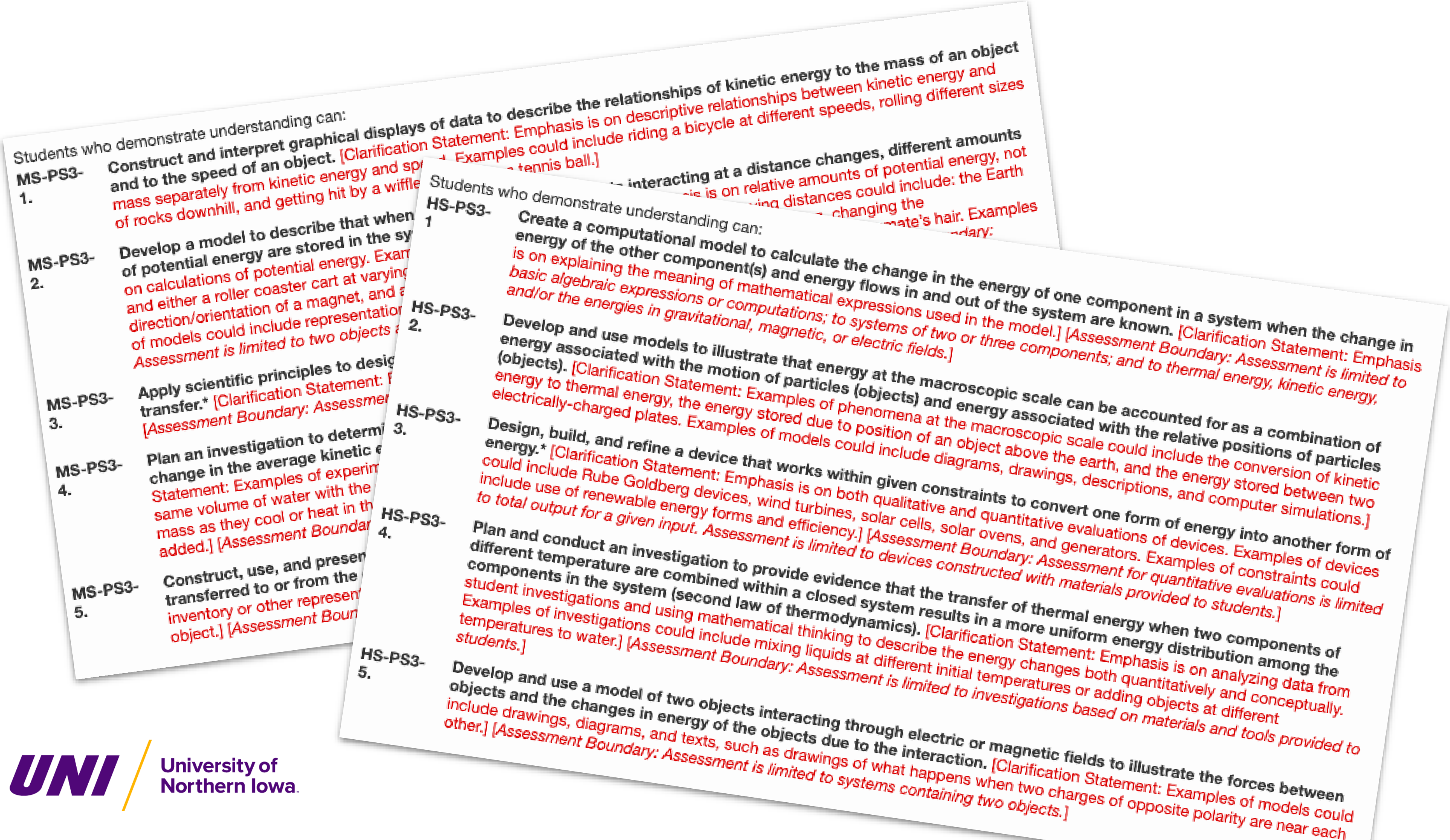

Students who demonstrate understanding can:

MS-PS3-1. **Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.** [Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and
mass separately from kinetic energy and sp
d. Examples could include riding a bicycle at different speeds, rolling different sizes
of rocks downhill, and getting hit by a wiffle
tennis ball.]

MS-PS3-2. **Develop a model to describe that when**
interacting at a distance changes, different amounts
of potential energy are stored in the sy
is on relative amounts of potential energy, not
on calculations of potential energy. Exam
ing distances could include: the Earth
and either a roller coaster cart at varying
changing the
direction/orientation of a magnet, and a
mate's hair. Examples
of models could include representation
ndary:
Assessment is limited to two objects a

MS-PS3-3. **Apply scientific principles to desig**
transfer.* [Clarification Statement: E
[Assessment Boundary: Assessmer

MS-PS3-4. **Plan an investigation to determi**
change in the average kinetic e
Statement: Examples of experim
same volume of water with the
mass as they cool or heat in th
added.] *[Assessment Boundar*

MS-PS3-5. **Construct, use, and presen**
transferred to or from the
inventory or other represen
object.] *[Assessment Boun*

Students who demonstrate understanding can:

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.** [Clarification Statement: Emphasis is on explaining the meaning of mathematical expressions used in the model.] *[Assessment Boundary: Assessment is limited to basic algebraic expressions or computations; to systems of two or three components; and to thermal energy, kinetic energy, and/or the energies in gravitational, magnetic, or electric fields.]*

HS-PS3-2. **Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative positions of particles (objects).** [Clarification Statement: Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically-charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations.]

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.*** [Clarification Statement: Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of renewable energy forms and efficiency.] *[Assessment Boundary: Assessment for quantitative evaluations is limited to total output for a given input. Assessment is limited to devices constructed with materials provided to students.]*

HS-PS3-4. **Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).** [Clarification Statement: Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water.] *[Assessment Boundary: Assessment is limited to investigations based on materials and tools provided to students.]*

HS-PS3-5. **Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.** [Clarification Statement: Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other.] *[Assessment Boundary: Assessment is limited to systems containing two objects.]*

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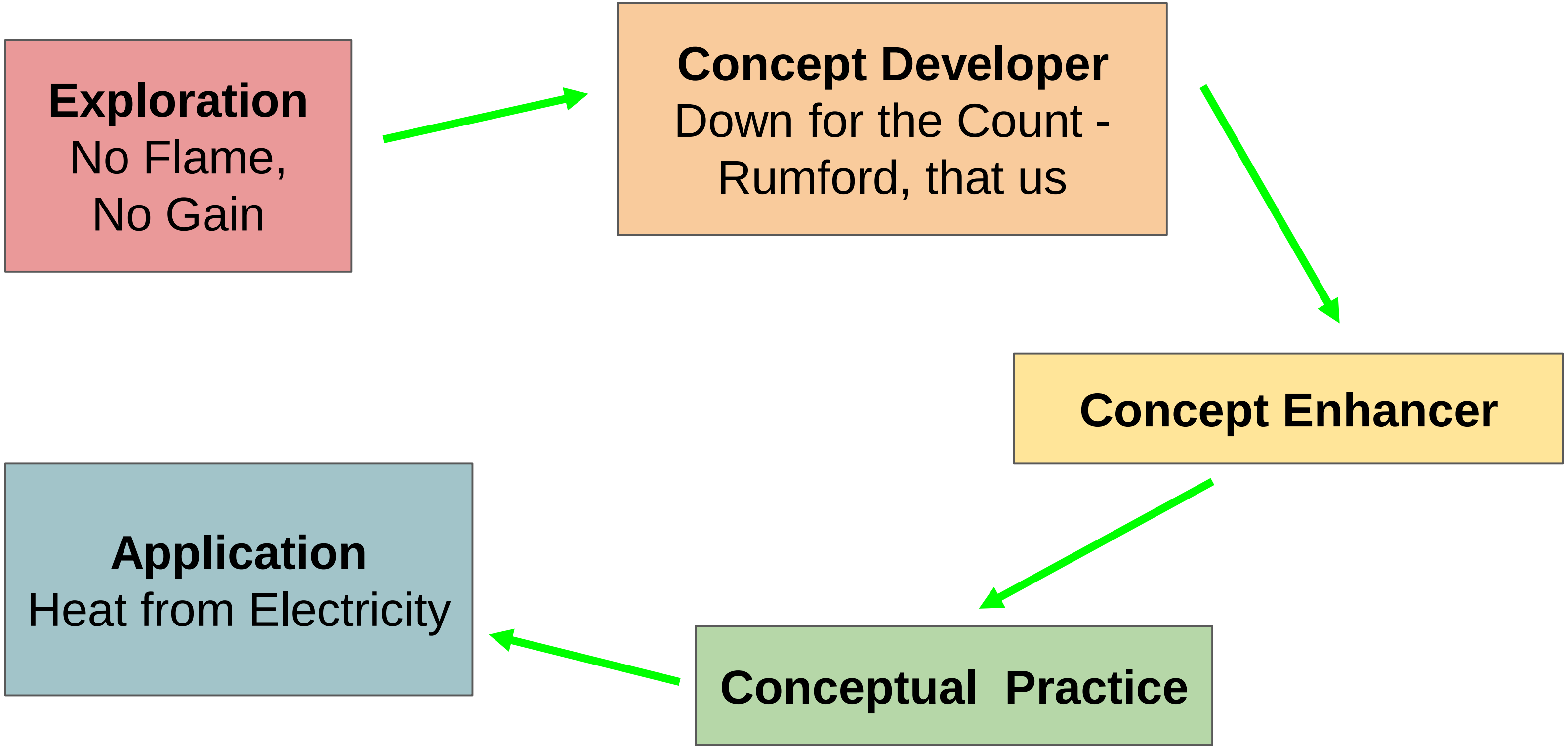
Learning Cycle Format



Exploration
No Flame,
No Gain

Concept Developer
Down for the Count -
Rumford, that us

Concept Enhancer

Conceptual Practice

Application
Heat from Electricity

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

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