TITLE: *FLORIDALEARNS STEM SCHOLARS* REGIONAL FORUMS	POLICY NO: FLSS - 006

I. Purpose

To establish guidelines for *FloridaLearns STEM Scholars* Regional Forums, including location determination, schedules, financial arrangements, student transportation, and content development and delivery.

II. Scope

This procedure addresses the structure, content development and delivery for *FloridaLearns STEM Scholars* Regional Forums across the three consortia.

III. Responsibility

Consortia personnel, regional college, community college, university personnel, project scientist, and project gifted expert will collaborate to ensure regional forum activities are appropriate for high school students who are gifted and talented.

IV. Definitions

Regional College, Community College, or University Personnel – Key individuals on the campuses of the regional colleges or universities that provide services to students in the consortia member districts.
Project Scientist – Scientist who is also CAS faculty and holds a Ph.D. in a scientific field.
Project Gifted Expert – Individual widely known for expertise in knowledge of characteristics of gifted students and qualities of instruction that meets needs of students who are gifted.

V. Policy Statements

FloridaLearns STEM Scholars will participate in two regional forums during year one (winter and spring) and four regional forums during subsequent years. Regional forums will offer Scholars opportunities to collaboratively problem-solve, develop leadership skills, and explore a variety of STEM careers. Each consortium will assume responsibility for planning and making necessary arrangements for the regional forums for their respective student participants. Consortia are strongly encouraged to involve regional colleges, universities, and/or community colleges. A limited amount of regional forum content will be developed with project funds and these activities/content will be shared among the consortia.

VI. Procedures

6.1 Determining Locations for *FloridaLearns STEM Scholars* Regional Forums

1. Consortia personnel will identify the regional colleges, community colleges, and universities that typically serve a majority of the students from the consortia districts. For regional forum activities, catchment areas for the regional colleges and community colleges are a very important consideration and this consideration should be given top priority.
2. Consortia personnel will meet with key personnel from the regional colleges, community colleges, or universities to determine interest and willingness regarding hosting *FloridaLearns STEM Scholars* activities on the respective campuses. A good entry contact is typically the Vice President of Instruction or Vice President of Academic Affairs who will involve other campus leaders as appropriate.
3. Ideally, regional forum activities will take place at a location no greater than 75 miles from the farthest high school that has participants.

6.2 Establishing Dates for *FloridaLearns STEM Scholars* Regional Forums

1. Each consortium in conjunction with their higher education partner(s) will determine whether regional forum activities will take place on a week day or weekend. Once this determination is made, specific dates will be established.
2. During year one, regional forums should be slated during the winter and spring and during subsequent years, regional forums should be slated for early and late fall (September and November), winter (January – February) and spring (April – May).
3. State testing dates should be avoided when dates are established and each district's calendar should be considered. Regional forum activities should not be scheduled during a holiday period of any district that has students participating in the regional forum.
4. The specific number of forums each consortium will hold during the stated time periods will be determined by the number of students the consortium is serving and budgetary constraints. For instance, while the Panhandle Area Educational Consortium will hold

five regional forums during each time period, Heartland Educational Consortium may only hold one forum during each time period.

6.3 Financial Agreements

1. Each consortium will determine what, if any, financial agreements will be needed between the consortium and higher education partner for regional forum activities. For example, the consortium may pay a facilities use fee or contract with higher education personnel to develop and/or deliver forum content. All agreements will be left to the discretion of each consortium.

6.4 Student Permission to Participate

1. STEM Mentor Teachers will distribute and collect field trip/off-campus permission forms. Students who have not returned appropriately signed forms to the STEM Mentor teacher, according to the STEM Mentor Teacher's timeline, will not be allowed to participate in the regional forum activity.

6.5 Regional Forum Transportation

1. Students will be transported to and from regional forum activities by district buses and STEM Mentor Teachers will maintain permission forms, accompany students on the bus, record student attendance on the school roster, and sign to verify.
2. Each consortium will negotiate transportation costs with their respective districts.
3. Each consortium will determine how the transportation arrangements will be made. For example, at Panhandle Area Educational Consortium the project consultant will communicate with each district's transportation director to negotiate costs, develop transportation contracts, and make requests for transportation.

6.6 Student Conduct

1. Students are expected to dress appropriately and in accordance with the policies of his/her local school for regional forum events.
2. Students are expected to abide by his/her respective district's *Code of Student Conduct* while taking part in regional forum activities.
3. Students who fail to comply with district policies will be referred by the STEM Mentor Teacher to the school principal for appropriate discipline.

4. Student infractions that result in suspension from school will automatically result in dismissal from the *FloridaLearns STEM Scholars* program.
5. Students are expected to engage in regional forum activities that they attend. Failure to engage may result in the recommendation for dismissal from the *FloridaLearns STEM Scholars* program.

6.7 Content Development and Delivery

1. Content for each *FloridaLearns STEM Scholars* Regional Forum should be developed to provide students opportunities to collaboratively problem-solve, gain familiarity with STEM careers, interact with higher education personnel, and develop leadership skills. Although it is highly desirable for each forum to include all of the aforementioned elements, specific forum activities may limit this. However, over the course of a year, all of the components should be adequately addressed.
2. Content may vary by location and according to regional college, community college, or university personnel. Consortia personnel are responsible for the agenda for each regional forum and regional forum content. They may collaborate with higher education contacts, other identified personnel, and/or partners to secure services for content development and delivery as needed.
3. Regional forum activities and content, developed with project funds, must be shared among consortia. It is also strongly suggested that all regional forum content, including that developed by consortia personnel, be shared among consortia.

6.8 Formatting and Development Guidelines for Regional Forum Content

1. Rationale

Content developed as a part of the *FloridaLearns STEM Scholars* project will be shared among Florida's three consortia: Panhandle Area Educational Consortium, Heartland Educational Consortium, and North East Florida Educational Consortium as they conduct Regional Student Forums and Summer Challenges. Additionally, plans are to eventually add these activities to Florida's CPALMS resources.

Formatting guidelines are to ensure all content:

1. Is detailed enough for another team to easily implement any activity as it is written.
2. Consistently has a uniform appearance and format.

2. Guidelines for Regional Forum Problem-Solving Module

Each module should be designed to:

1. Have a problem-solving focus and afford students an opportunity to extend existing content knowledge.
2. Bridge a morning and may involve students working on a single problem, or a series of problem-solving activities with the same general focus.
3. Include collaboration among students, preferably in groups of no more than three.
4. Include overlap among the areas of science, technology, engineering, and math (STEM) wherever possible.
5. Instruction should be innovative and allow students to apply knowledge and skills.
6. Include data collection if at all possible.
7. Require students to "make sense" or think about and explain their thinking based on their data.
8. Afford opportunities to present findings to a larger group. This may range from a limited number of groups sharing findings with each other to sharing with the group at large.
9. Allow time for revision or redesign.

STEM Tips

1. **Students enjoy competitions.**
2. **Peer-review is powerful.**
3. **Worksheets should be used sparingly, if at all!!**

<u>Module Components</u>

The components of each regional forum module should include the following sections in the sequence listed:

1. Title: The title should be creative – catchy, yet informative.
2. Description: A short description of the forum activity.
3. Objectives: What are the expected student outcomes in terms of what they will learn, do, and understand?
4. Standards: What *Common Core* or *Next Generation Sunshine State Standards* is/are the activity/ies aligned to? The standards may be accessed online through CPALMS at www.floridastandards.org.

5. Materials: List of items, number of items needed and, if the item is a specialty item, the source. If advance preparation of a specific material is required, add instructions for preparation in the teaching notes.
6. Student Handouts: List the name of each handout in the order of use.
7. Procedure: Develop a numbered list of steps in the sequence in which they should occur.

8. Teaching Notes: Detail information that will help a person who has never conducted this activity to complete it successfully and with little difficulty. These should include:
    a. How to prepare any materials that require advanced preparation.
    b. Specific tips for running the activity smoothly.
    c. A summary of the typical or expected results.
9. References: If the activity isn't original with you, provide appropriate citations in APA format.
10. A Word form is provided (see forms).

PowerPoint Guidelines

Use the template provided. Fonts and margins are pre-set for you.

1. Avoid using shadowed fonts in headings, because they don't look as sharp when printed.
2. Reduce the language on the slide, keeping it as simple as possible.
3. Provide diagrams, pictures, etc. that help tell your story and feel free to use colored fonts, shapes, and call-outs as needed.
4. Hyperlink to outside videos as needed, but reference the name and URL of the video in the notes.
    a. Access to online videos is blocked in many school districts, so the presenter may need to download outside media onto his/her computer ahead of time.
    b. If the link is broken, the name of the media may allow the presenter to find it at another location.
5. Add comments and explanations that will help another instructor in the notes.
6. Use APA format to appropriately cite pictures, graphs, tables, information, or other materials that are not original to you. Do this both in the footer of the slide and notes.

Policies and Procedures

Document Formatting Details
Font: Cambria
Font Size:
- **Headings – 12 point underlined**
- **Text – 11 point**

Margins:
- **Top – 1 inch**
- **Left and Right -1 inch**

As the problem-solving module is being developed, ask yourself:

1. **Engage**
   Does the activity promote curiosity, make connections between students' past and present learning experiences, expose prior conceptions, and organize students' thinking toward learning outcomes of current activities?
2. **Explore**
   Do the activities help students use prior knowledge to generate new ideas, explore questions and possibilities, and design and conduct an investigation?
3. **Explain**
   Are learners given an opportunity to explain their understanding of the concept?
4. **Elaborate**
   Do students have opportunities to apply their understanding of the concept by conducting additional activities?
5. **Evaluate**
   Are students and facilitators given an opportunity to determine students' progress toward achieving the educational objectives?

(Bybee et.al, 2006)

Forms

1. Regional Forum Activity Template
2. Sample Student Roster
3. Sample Regional Forum Activity

Regional Forum Activity Template

Title
Description
Objectives
Standards Alignment
Materials
Student Handouts
Procedure
Teaching Notes
References

SAMPLE

Jackson County
Marianna High School
FloridaLearns STEM Scholars
Student Roster

Name	Chipola Regional Forum 01-13-12	Chipola Regional Forum 04-20-12
STEM Mentor Teacher		
1.		
2.		
3.		
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6.		
7.		
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12.		
13.		
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15.		
16.		

STEM Mentor Teachers

Please record attendance while you are traveling to the regional forum and hand the sheet to Brenda Crouch or Caren Prichard. If for some reason, you fail to do this, please fax the sheet to the attention of Denise Brock at 850-638-6109. If you need a copy, please indicate on the bottom of the form and we will e-mail a copy to you on the next work day

I hereby verify this attendance is accurate ______________________________ __________

(Signature) (Date)

FloridaLearns STEM Scholars
Regional Forum
Mousemobile Design Challenge

Title
Mouse Mobile Design Challenge
Description
Students will build a "car" using a standard mouse trap as the source of energy. A box of supplies will be provided and students will be given 1.5 hours to complete their mousetrap powered car.
Objectives
1. Students will design and construct a "car" with the sole source of power being a mousetrap, using only the supplies given. 2. Students will give an example of frame of reference. 3. Students will distinguish between speed and velocity and distance and displacement. 4. Students will record time and the distance traveled by the mousetrap car to determine velocity. 5. Students will explain the concept of torque and how it is applied in the activity. 6. Students will distinguish between the tension force and the frictional force. 7. Students will explain the chemistry of an adhesive that dries as opposed to one that cures.
Standards Alignment
SC.912.P.12.1 Distinguish between scalar and vector quantities and assess which should be used to describe an event. SC.912.P.12.2 Analyze the motion of an object in terms of its position, velocity, and acceleration (with respect to a frame of reference) as functions of time. SC.912.P.12.3 Interpret and apply Newton's three laws of motion. SC.912.P.12.9 Recognize that time, length, and energy depend on the frame of reference.
Materials
Into each two gallon Ziploc place: Balloons - 6 Cardboard – 10 X 10 piece CD (4 large, 2 small) Cup hooks – 4 Design Challenge Handout Dowels – 3 Duct tape – one roll per classroom of 24 students Eye hooks – 4 Florist wire – 4 pieces Mouse traps (2 per kit – those from Wal-Mart are best) Pens (smooth) can remove barrel Project board (cut) into rectangles – 9" long by 4" wide Rubber bands - 6 Small metal loaf pan Scissors Smooth round pencils

String
Fast-Drying Gorilla Glue – 2 tubes per classroom of 24 student
Thread spool
Tops from pop cans - 6
Zip ties (at least two sizes)
Yarn – 1 yard
Ziploc bags (two gallon)

Student Handouts

1. Design Challenge
2. Integrated Content

Procedure

1. Prior to the regional forum date, assemble items from the materials list, in the specified amount, into two gallon Zip Loc bags (one bag per each group of three students).
2. Make arrangements to divide students into work groups of no more than three students. Colored dots and numbers on the name tags are a suggested way to do this.
3. Ideally, students in each group will be from different districts or schools and designations, such as symbols or numbers, on name badges may be used for this purpose.
4. Assemble students in the work area and explain that:
   A. All electronic communication devices must be turned off and put away. Any group that uses an electronic communication during the "work time" will be disqualified.
   B. Each group will be given a bag of identical materials for the activity and have 90 minutes to collaboratively design and develop the product, a car, powered solely by a mousetrap.
   C. There are many possible designs, but only **one** will be **the** winner.
   D. Distribute supply packs and begin the 90 minute design and construction period.
5. Teachers should circulate during this time, but may not give ANY guidance to students.
6. Competitions – We found that measuring distance traveled works best, because most cars won't go very far. Prizes were also awarded for the car that climbed the highest distance on a ramp that had a tilt of about 40 degrees and the most creative design.

Teaching Notes

Students will be divided into groups of three. This will be done before students arrive.
Because there are several sites on the internet that show how to construct a mouse mobile, it is important to monitor the students to assure that they are not using their phones for an unfair advantage.

References

http://www.hofstra.edu/pdf/academics/colleges/soeahs/ctl/ctl_informed_mousetrap_guide.pdf
http://www.hofstra.edu/pdf/Academics/Colleges/SOEAHS/ctl/ctl_informed_mousetrap_activity.pdf
http://www.scienceguy.org/Articles/MousetrapCarConstructionArticlePlan.aspx
http://www.instructables.com/id/Mousetrap-Vehicle/

FloridaLearns STEM Scholars
Design Challenge and Competition

YOUR MISSION SHOULD YOU CHOOSE TO ACCEPT IT

Use the materials supplied and the ingenuity and imagination of your team to design and build a rolling vehicle that is powered by a mouse trap (or two).

Some goals that can lead to a successful competition:

1) How far can it go?
2) How imaginative is your design?
3) How much weight, or how steep a hill can it manage?

The Judges will consider ***one or more*** of these attributes in determining a ranking for the completed projects.

Some hints to get started:

1) Strength and stability are important.
2) Friction should be reduced as much as possible.
3) The simpler the design, the better.

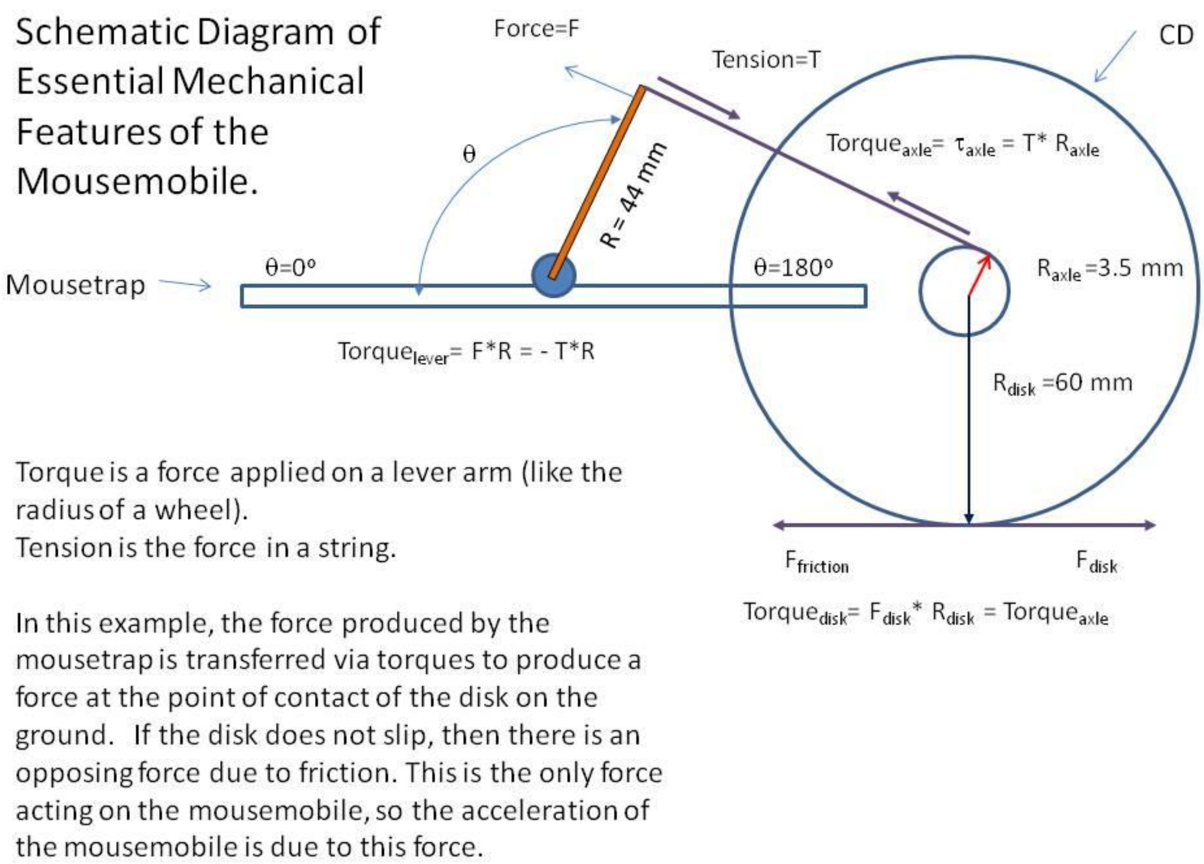
The Competition

1) Two Group finalists picked during each "Room" competition.
2) Ten finalists will compete in "Forum" competition.

As always, should anyone on your team be caught, the Secretary will disavow any knowledge of your actions. Good luck, scholars!
These instructions *may* self-destruct in five seconds.

WHAT CAN WE LEARN FROM THE “MOUSEMOBILE” CHALLENGE?

As the mouse says, “there are many ways to fool a cat”, and that is also true for the many different mousemobiles that you have constructed. I also made one, so to make things simple, I will just use mine as an example of the incredible amount of science that lurks in the mouse trap. Here is a breakdown of some of the many scientific and engineering aspects involved. Note that the text below summarizes the concepts which are enough to get the basic ideas. *At the end of this handout, some details of the math and physics I used are presented so you know where the numbers come from!*



<u>1) Force and torque, storing and using energy.</u> The basic idea is that you can store energy by stetting the trap, and then transfer that potential energy to the kinetic energy of the moving vehicle. Here is the pathway:

A. You put energy into the mouse trap by doing work against a spring using a lever. The closer the lever is to the trigger side, the more **force** you need to move the lever.
   - If you think about it, the lever moves through **180 degrees**, and the spring is twisted tighter on the axle of the trap.
   - I used a fish scale to measure the maximum force needed to hold the lever down, which was about **1.1 pound (or ½ kg or about 5 Newtons)**.
   - Since the force is applied to a **lever (44 mm in length)** which rotates, we are actually putting **torque** on the spring system when we set the trap.
   - I estimate **the energy stored in the trap is about 0.35 Joules.**

B. The next step is to transfer the energy of the trap to the axle and wheel of the vehicle.
   - For this a string is tied to the lever and wound around the axle.
   - When the trap is triggered, the torque of the spring produces a force on the string (called **tension**) and this in turn produces a torque on the **axle that is 7 mm in diameter**.
   - Since the wheels are fixed to the axle, this torque is transferred to the wheels, making them turn.
   - If the wheels do not slip, the torque on the **wheels (120 mm in diameter)** produce a force at the point of contact with the ground, and since **Newton's laws say that for every force, there is an equal and opposite force**, the vehicle must move in the other direction, since Newton also says that **force = mass*acceleration**.

C. A special feature of the mousemobile is that the lever only moves 180 degrees, and that determines the total length of the string that is under tension. From that we can figure out how many turns the wheels will make "under power".
   - If you think about it, the length of string pulled off the axle while it is under tension is just the starting and final distance that the lever end (where the string is tied) goes from 180 to 0 degrees, which is just 88 mm.
   - Since the axle (where the other end of the string is fixed) is 7 mm in diameter, the **axle will turn 88 mm/π*7 mm = 4 turns**!
   - This means the wheels will also turn 4 times while under power, so the vehicle will be under power for 4*π*120 mm = 1508 mm or about 1.5 meters, or about 5 feet.
   - **IF there is no friction**, it will keep going. Otherwise, it will stop quickly.

2) Energy and friction. As you can see, the physical details of the mousemobile propulsion system are very complicated, and I have left out a lot of subtle details that have to do with what is going on as the lever moves from 180 to 0 degrees. However, the **conservation of energy** allows us to make some predictions about what will happen after the trap has sprung completely, without a detailed consideration of all the forces and torques that are operating during the acceleration period. Here is how it goes.

A. We know **we started with about 0.35 Joules of energy, stored as potential energy (PE) in the spring.** This energy is available to be used the make the vehicle move and if there is no friction, **it can be converted into kinetic energy (KE)** of the same amount.

B. If you look at the vehicle, it has two types of moving parts when rolling.
   - *First* the body of the mousemobile moves in a straight line, and it has **linear motion kinetic energy**. I measured the mass of the body of the vehicle and it is 130 grams.
   - *Second,* the wheels are not only moving linearly, but they are also rotating. So there is an additional **rotational kinetic energy**. Since the wheels are so light (only 20 grams each), we will not include the rotational energy.

C. The linear kinetic energy is just ½ the mass times the speed squared **($KE = ½ mv^2$)**. So, if **PE = 0.35 J of potential energy** is converted completely into kinetic energy **KE** we can figure out how fast the vehicle will go.
   - The mass of the **vehicle is 0.130 kg**, so the speed is <u>the square root of 2*PE/m</u>, which **is v = 2.2 meters/second**.
   - This would be the **maximum speed** of the mousemobile if we ignore friction and the rotation energy of the wheels.

D. I took a movie of my mousemobile, and it went 17 feet (about 5 meters) in 5 seconds.
   - From this I estimated the **average speed** to be **v = 1 meter/second.**
   - Friction causes a force which acts against the motion of the vehicle the whole time it is moving, and takes some (apparently a lot!) of the energy that was originally available.

In this section, we go into more depth than in the first part of the Content Handout. You may want to share and explore this with your teachers and other students in your science classes. Because the Mousemobile involves <u>circular motion</u>, it is really a very advanced example of mechanical systems.

The Energy Stored in a Mousetrap. (To make things easy, always put your parameters in kilograms, meters, seconds, and radians when doing "serious" calculations. That way the units will always come out as Newtons, Joules, etc.)

Work = Force*Distance (this is the force your finger puts on the mouse trap lever *times* how far the end of the lever moves).

Force = k*Distance (k is a constant that says that the more you move the lever, the harder it gets to move).

The lever moves in a circle, so we have to use the angle θ.
Distance = θ*R (this says that the lever end moves on a circle of radius R: you know that if you could go *completely* around, this distance would be the circumference of the circle: C = $2\pi R$).

So the Force = k*R*θ, and the Distance is R*θ.
Since the Work = Force*Distance, this means the Work is proportional to $k*R^2*\theta^2$. Actually, since the Force increases as you increase θ, the Work is ½ $k*R^2*\theta^2$. *(Using calculus, you will get this exact answer. In pre-calculus, you can get this answer using the average work, or using the area under the Force-Distance triangle.)*

I knew that it took 5 Newtons of force to hold the 44 mm lever at 180^o (or π radians), so k = 36 N/radian, and ½ $k*R^2*\theta^2$ = 0.36 Joules! This is how much energy is stored in the spring.

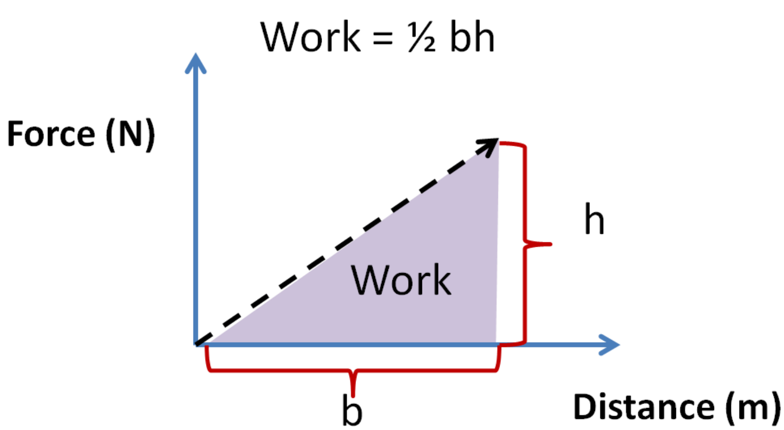
Not all of this energy goes into the linear motion of the Mousemobile which has kinetic energy ½ mv^2. Some of the energy goes into the rotational motion of the wheels. Using arguments much like the ones above, one can figure out that the kinetic energy of a spinning wheel is. If the wheel has a radius R, and a mass M, then if it is moving on the ground with speed V, the <u>rotational kinetic energy</u> is KErotational = ¼ MV^2. This is in addition to the <u>linear motion kinetic energy</u> KE_{linear} = ½ MV^2.

So, if we consider the mass of the mousemobile, including the wheels, the linear KE is ½ (0.130 kg) V^2 and the rotational KE of all four wheels is 4* ¼ (0.02 kg) V^2, then this must add up to the stored energy 0.35 Joules. We can find the maximum speed, which is about 2 m/s. This is still more that I observed, so friction in the axle and other factors take a lot of the stored energy.

FloridaLearns STEM Scholars
Design Challenge and Competition

Buzz words and quiz questions for today.

1) What is the difference between the friction between the wheel and the ground, and the friction in the axle bearings? Which dissipates energy and which doesn't?
2) What about the tension in the string when we trigger the mouse trap? When is it zero, and when is in maximum?
3) What happens to the values of the force, torque, distance under power, etc. if you extend the lever on the mouse trap (like in many YouTube videos). If there is no energy lost due to friction, does it go faster, farther?
4) How is the spring in the mouse trap different than the spring on a screen door? And….. does the screen door spring cause a torque?
5) Plot the force k*R*□ (y-axis) as a function of distance on the circle R*□□ (x-axis) on a graph. What is the area under the curve? Hint: the area of a triangle is ½ the base times the height. This is a "pre-calculus" way to calculate work!



(Materials prepared by James S. Brooks and Brenda Crouch. For comments, corrections, ideas, etc., please email jbrooks@fsu.edu.)