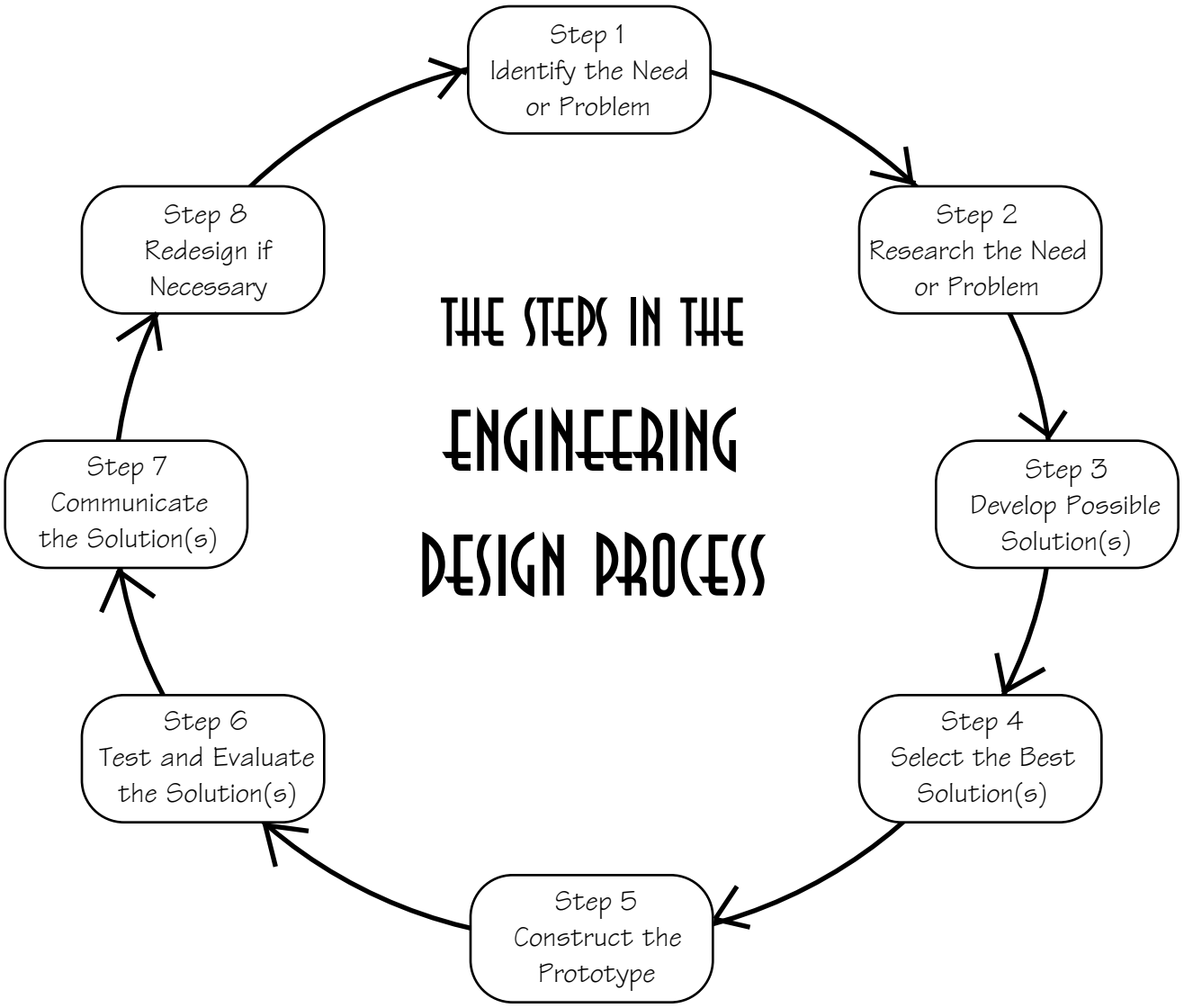


1. Identify the need or problem
2. Research the need or problem
   - examine current solutions
   - explore other options via the internet,
   - library, interviews, videos, etc
3. Develop possible solution(s)
   - brainstorm possible solutions
   - use your knowledge of science and math
   - present the solutions using "thumbnail sketches" , "rough sketches", and "working drawings"
4. Select the best possible solution(s)
5. Construct the Prototype
6. Test and evaluate the solution(s)
   - does it work?
   - does it meet the original design constraints?
7. Communicate the solution(s)
   - Make a presentation that includes a discussion of how the solution(s) meets the needs of the original problem or need
8. Redesign (if necessary)
   - Overhaul the solution(s) based on information gathered during the tests and presentation

SCIENCE & TECHNOLOGY CURRICULUM FRAMEWORK

Standards addressed in mousetrap race activity

1. Materials, Tools, and Machines

- 1.1 Given a design task, identify appropriate materials (e.g., wood, paper, plastic, aggregates, ceramics, metals, solvents, adhesives) based on specific properties and characteristics (e.g., weight, strength, hardness, and flexibility).
- 1.2 Identify and explain appropriate measuring tools, hand tools, and power tools used to hold, lift, carry, fasten, and separate, and explain their safe and proper use.
- 1.3 Identify and explain the safe and proper use of measuring tools, hand tools, and machines (e.g., band saw, drill press, sanders, hammer, screwdriver, pliers, tape measure, screws, nails, and other mechanical fasteners) needed to construct a prototype of an engineering design.

2. Engineering Design

- 2.1 Identify and explain the steps of the engineering design process, i.e., identify the need or problem, research the problem, develop possible solutions, select the best possible solution(s), construct a prototype, test and evaluate, communicate the solution(s), and redesign.
- 2.2 Demonstrate methods of representing solutions to a design problem, e.g., sketches, orthographic projections, multi view drawings. 2.3 Describe and explain the purpose of a given prototype. 2.4 Identify appropriate materials, tools, and machines needed to construct a prototype of a given engineering design.
- 2.5 Explain how such design features as size, shape, weight, function, and cost limitations would affect the construction of a given prototype.

3. Communication Technologies

- 3.2 Identify and explain the appropriate tools, machines, and electronic devices (e.g., drawing tools, computer-aided design, and cameras) used to produce and/or reproduce design solutions (e.g., engineering drawings, prototypes, and reports).
- 3.3 Identify and compare communication technologies and systems, i.e., audio, visual, printed, and mass communication.

4. Manufacturing Technologies

- 4.4 Explain basic processes in manufacturing systems, e.g., cutting, shaping, assembling, joining, finishing, quality control, and safety.

6. Transportation Technologies

- 6.1 Identify and compare examples of transportation systems and devices that operate on each of the following: land, air, water, and space.
- 6.2 Given a transportation problem, explain a possible solution using the universal systems model.
- 6.3 Identify and describe three subsystems of a transportation vehicle or device, i.e., structural, propulsion, guidance, suspension, control, and support.
- 6.4 Identify and explain lift, drag, friction, thrust, and gravity in a vehicle or device, e.g., cars, boats, airplanes, rockets.

STEP 1 - IDENTIFY NEED OR PROBLEM

Given a mouse trap and a limited set of materials, design a mouse trap racer that will travel at least 25 feet on a linoleum floor. You may use any materials found in the Tech Lab as well as any materials that you bring in from home, but the racer must get its power from the mouse trap and nothing else.

You will research design, test, evaluate, and present your findings following the steps in the "Engineering Design Process" found in this packet. Your presentation will consist of a display made from cardboard that will hold your finished vehicle as well as any printed publications that you create (i.e. your journal, sketches, final drawing, etc.)

You will have 10 class periods to complete the project and an additional 3 class periods to complete the presentation. All presentations will be displayed at the "Technology Night Fair" in May which will be open to the public.

1. Students will each design, construct, test and evaluate their own mouse trap racer
2. Students will design a vehicle using the steps in the Engineering Design Process
3. Students will have access to the parts listed below in the "Mouse Trap Vehicle Kit"
4. Students will have 10 classes to complete construction and testing of their vehicle
5. Final Testing will be conducted during the 11th class
6. Each vehicle must race 3 times, with the results being recorded on the Results Sheet
7. Results for <u>each</u> vehicle must then be entered into a spreadsheet on the computer
8. Class results will be posted
9. Students will keep an electronic journal of their <u>daily</u> progress at the end of each class to assist them when creating their presentations
10. Cars will be modified whenever a student sees fit

THE MOUSE TRAP VEHICLE KIT WILL INCLUDE.....

- 1/4" thick Eastern White Pine -for construction of the "chassis"
- 12" of string - used to connect the mouse trap arm to the axle
- 4 - washers - for reduction "friction" between the wheel and the chassis
- 2 axles - used to connect one wheel to another
- mouse trap - power source (changes "Potential Energy" to "Kinetic Energy")
- CD's and cardboard for wheels plus 1" plastic wheels
- plastic insert adapters for centers of CD's
- coat hangers for mousetrap arm extenders
- masking tape
- 1/8 and 1/4 inch dowels for axles
- polystyrene foam (rigid insulation)

STEP 2 - RESEARCH

DEFINITIONS:

Define the following words so that when we discuss your vehicle, you will better understand the points I am trying to make. Use the orange dictionaries at the front of the room.

1. chassis: _____
2. Potential Energy: _____
3. Kinetic Energy: _____
4. axle: _____
5. friction: _____

INTERNET RESEARCH:

To further research the topic, we will now head to the Internet.

- Go to the Brown Middle School web site (http://www.newton.mec.edu/Brown/TE/te.html)
- Click on the "It's a Girl Thing" button
- At the bottom of the page, click on "PROJECTS"
- Click on "Doc Fizzix"
- Once at the site, scroll down and one at a time, take a look at mousetrap car kit, mousetrap racer distance kit, and mousetrap dragster kit.
- In the boxes below, sketch each of the three racers shown in the kits

mousetrap car kit	mousetrap racer distance kit	mousetrap dragster kit

INTERNET RESEARCH: (CONT'D)

To further research the topic, we will now head to the "It's a Girl Thing" site

- Click the BACK button on your browser
- Click on the How They Work button
- Answer the following questions based on the article at the site

1. A mouse-trap car is powered by the energy of a wound up _____-_____ _____.
2. One end of a string is attached to the end of a lever arm that is attached to the mousetrap's "_____".
3. The other end of the string has a _____ _____ that is designed to catch a hook attached to the drive axle.
4. As the drive axle is turned, the string catches the _____ and winds around the _____, the mousetraps "snapper" arm is pulled towards the drive axle causing the mousetraps spring to be wound.
5. Once the mouse-trap's is released, the string is pulled off the _____ _____ causing the drive axle and the wheels to rotate.

STEP 3 - SUGGEST POSSIBLE SOLUTIONS

"THUMBNAIL SKETCHES:

Sketch some of your ideas for your Mousetrap Racer is the boxes provided below

STEP 4 - CHOOSE BEST SOLUTION (ROUGH SKETCH)

DIRECTIONS:

1. Choose your best design from the previous sheet
2. In the box provided below, draw a "Rough Sketch" of your design (top and front views)
3. The Rough Sketch should have detail and be much larger

ROUGH SKETCH

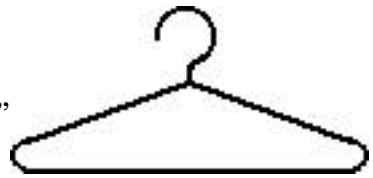
Top View

Front View

STEP 5 - BUILD THE "PROTOTYPE"

DIRECTIONS:

- Decide what type of material to use for your "chassis"
- Cut the chassis pieces and glue them together
- Drill holes for your axles (hand drill or drill press)
- Cut your axles to length (band saw or wire cutters)
- Attach your "nail" to your rear axle (hand drill)
- Using the "jig" at the Band Saw, cut your wheels
- Attach your axles and wheels to your chassis (hammer)
- Attach your mouse trap to your chassis (masking tape)
- Make your "extension arm" for your mouse trap (coat hanger)
- Attach your extension arm to your mousetrap
- Cut and attach your string to the arm and the rear axle

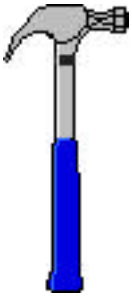


COAT HANGER

HAND DRILL

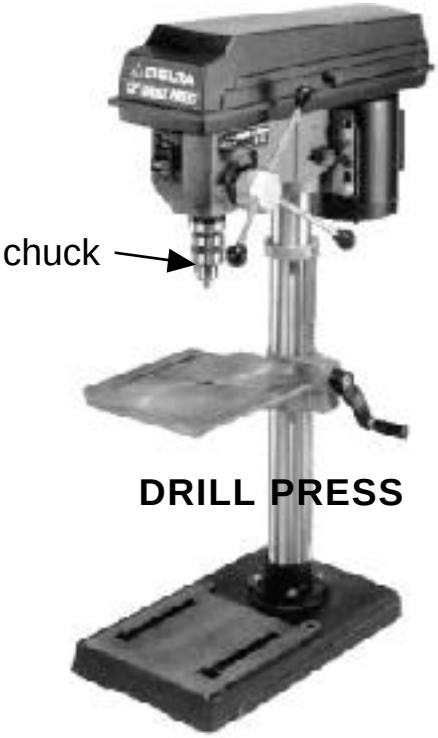
TAPE

MOUSE TRAP

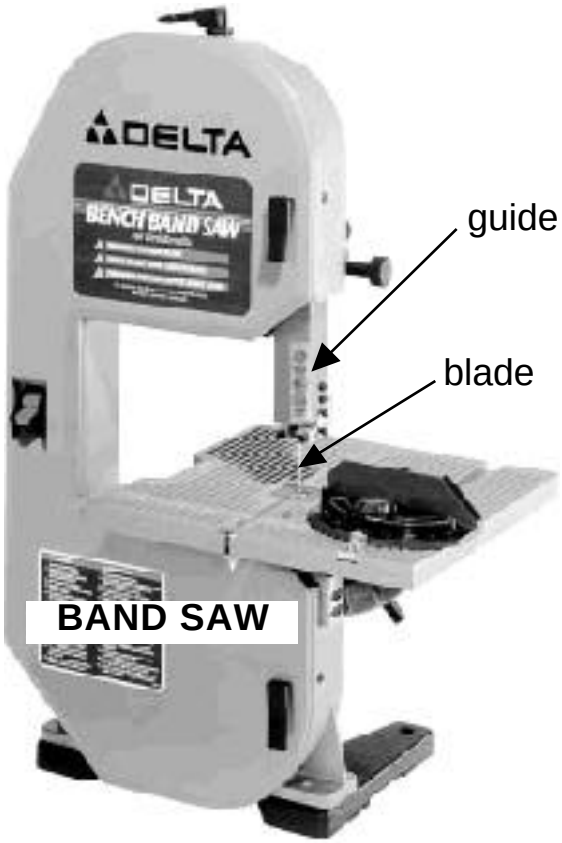


HAMMER

WIRE CUTTERS



DRILL PRESS



BAND SAW

STEP 6 - TEST & EVALUATE

DIRECTIONS:

You will be testing your Mouse Trap Racer at least once each day and recording how well it performed. You will also be recording any problems that you discover and what you plan to do to solve the problem after each test.

THE FIRST TEST

1. How far did your Mouse Trap Racer travel? _____
2. What actually happened? Describe. _____

   _____
3. What will you do to fix it? _____

   _____

THE SECOND TEST

1. How far did your Mouse Trap Racer travel? _____
2. What actually happened? Describe. _____

   _____
3. What will you do to fix it? _____

   _____

THE FINAL TESTS

1. How far did your Mouse Trap Racer travel in TRIAL 1? _____ FEET
2. How far did your Mouse Trap Racer travel in TRIAL 2? _____ FEET
3. How far did your Mouse Trap Racer travel in TRIAL 3? _____ FEET

Weight in grams: _____ grams	Average Distance: _____ FEET

MATH CONNECTIONS

MATH PREDICTIONS:

Below you will find several math problems that relate to predicting success for your Mouse Trap Racer. Complete each problem (use a calculator if you wish)

1. Determine the circumference of your drive wheels (rear wheels)

   The formula for Circumference is **π D = C**

   π=3.1416

   D=diameter of the wheel

   C=circumference of the wheel

   For an 8" Diameter wheel.....

   3.1416 X 8" = C or **25.133 inches**

Your Circumference

π X D = C

3.1416 X ____ = _____"

_____ inch circumference

2. Determine the number of times the wheel must rotate to travel 25 feet

   a. **25' X 12" = 300"**

   b. **300" / 25.133 = 11.936** rotations

Your Number of Rotations

25' X 12" = 300"

300" / _____ = _____ rotations

3. Determine the the circumference of the centerline of the string wrapped once around the axle which will help us calculate the length of the string required (example: 1/8" diameter axle and 1/8" diameter string - 1/8" is equal to .125)

   a. **D = .125 +.125 = .250**

   b. **πD = 3.1416 X .250 = .785"**

   c. **11.936** (rotations) **X .785 = 9.37"**

Your Length of String

D = ._____ +._____ = ._____

3.1416 X ._____ = ._____

_____(rotations) **X ._____ = _____**

SCIENCE CONNECTIONS

Newton's Laws

- Newton's 1st Law: *A body that is in motion continues in motion with the same velocity (at speed and in a straight line), and a body at rest continues at rest unless an unbalanced force acts upon it.*

- Newton's 3rd Law: *For every action there is an equal and opposite reaction which has the same force but is opposite in direction.*

RELATING NEWTON'S LAWS TO OUR VEHICLES:

- Visit the Brown Technology Education web site (http://www.newton.mec.edu/Brown/TE/te.html)
- Click on the Dragsters button
- Click on the "Laws of Motion" button
- Visit each of the sites, read the articles, and view the animations

1. Explain how Newton's Laws of Motion is important to your Mouse Trap Racer

_____

_____

_____

_____

2. What causes your car to accelerate? _____

_____

3. What causes your car to decelerate? _____

_____

4. If there were no air or no gravity, what would happen to the racer once it was started?

_____

STEP 7 - COMMUNICATE SOLUTIONS

WHAT DID I DOE FOR EACH OF THE STEPS OF THE ENGINEERING DESIGN PROCESS

Step 1: Identify the need or problem _____

_____

Step 2: Research _____

_____

Step 3: Suggest Possible Solutions _____

_____

Step 4: Choose the Best Solution _____

_____

Step 5: Build the Prototype (experimental model) _____

_____

_____

_____

_____

_____

Step 6: Test and Evaluation the Solution _____

_____

_____

_____

Step 7: Communicate the Solution _____

_____

Step 8: Redesign if Necessary_____

_____

Technology/Engineering: "It's A Girl Thing"

CHARLES E. BROWN MIDDLE SCHOOL

MR. SYLVIA

NAME ____________

GRADE ______ CLUSTER ______

STEP 8 - REDESIGN IF NECESSARY

Answer the following;

1. Did your racer work properly the first time you tested it? Explain

_____

_____

_____

2. What did you do to your racer to improve its performance?

_____

_____

_____

3. Did your racer perform properly the second time you tested it? Explain

_____

_____

_____

4. What did you do to your racer to improve its performance this time?

_____

_____

_____

5. If you were starting from scratch, what would you do differently?

_____

_____

_____

WEB SITES THAT HELPED

Sites That Helped

Dr. Fizzix Homepage - The Ultimate Web Site with everything, including a book about mouse trap racers
http://www.docfizzix.com/

Dr. Fizzix Car Propulsion - A complete description with photos of how mouse trap racers are propelled
http://www.docfizzix.com/mousetrap_racer_propulsion.htm

Dr. Fizzix Tips - Complete set of links that give tips on everything from axle hooks to loop knots
http://www.docfizzix.com/mouse_trap_cars_tips.htm

ScienceNet - Complete set of instructions and tips for building a mousetrap car. Step by step, with photos of how to construct.
http://www.cmi.k12.il.us/Urbana/projects/apple/sciencenet/projects/mcars.html

Mouse Trap Cars - Web site has 2 downloadable files...one hqx and one PDF
http://explorer.scrtec.org/explorer/explorer-db/html/783751209-447DED81.html

Mouse Trap Contest - List of Race Rules
http://cghs.dade.k12.fl.us/secme/mousetrap.html

FunTraps - This is it! Your ultimate source for mousetrap powered cars, for variety and simplicity. This unique book contains detailed step-by-step plans and instructions for building a wide variety of exciting cars and vehicles powered only by mouse traps.
http://www.funtraps.com/web01/page_common/book_tbimc.asp

Gallery - Complete photo gallery of mouse trap racers. Some of the best samples on the net
http://can-do.com/uci/ssi2002/gallery.html

Newton's Laws - Site contains complete explanations of Newton's 1st and 3rd Laws of Motion. Animations are included to further explain the concepts.
http://www.newton.mec.edu/Brown/TE/DRAGSTERS/NEWTONSLAWS/index.html

Gallery Walk - Great link with lots of photos of mouse trap racers
http://www.lausd.k12.ca.us/Lincoln_HS/Gallery/ms-car.htm

HIES Mousetrap Racer Photos - Great set of mouse trap racers
http://cpphysics.homestead.com/mousetrap3.html

University of Idaho - Click on a thumbnail to get a larger picture
http://itednt.ited.uidaho.edu/images/Mousetrap/mousetrap.htm

Mr. Nydegger's Cars - Click on a thumbnail to see a larger photo
http://24.190.139.131/Elem/Grade4/4N/Mousetrap/mousetrap.htm

ScienceNet - Great site with links to mousetrap information (tips) as well as other projects
http://www.cmi.k12.il.us/Urbana/projects/apple/sciencenet/projects.html

ScienceNet - Complete set of instructions, step by step, for building a mousetrap racer. Four Stars!
http://www.cmi.k12.il.us/Urbana/projects/apple/sciencenet/projects/mtchints.html

International School of Prague - Great mousetrap car photos
http://web.isp.cz/web/science/mousetrapcar/models2002.htm