TRAC

Transportation and Civil Engineering

Michigan Department of Transportation

TRAC Engages Students

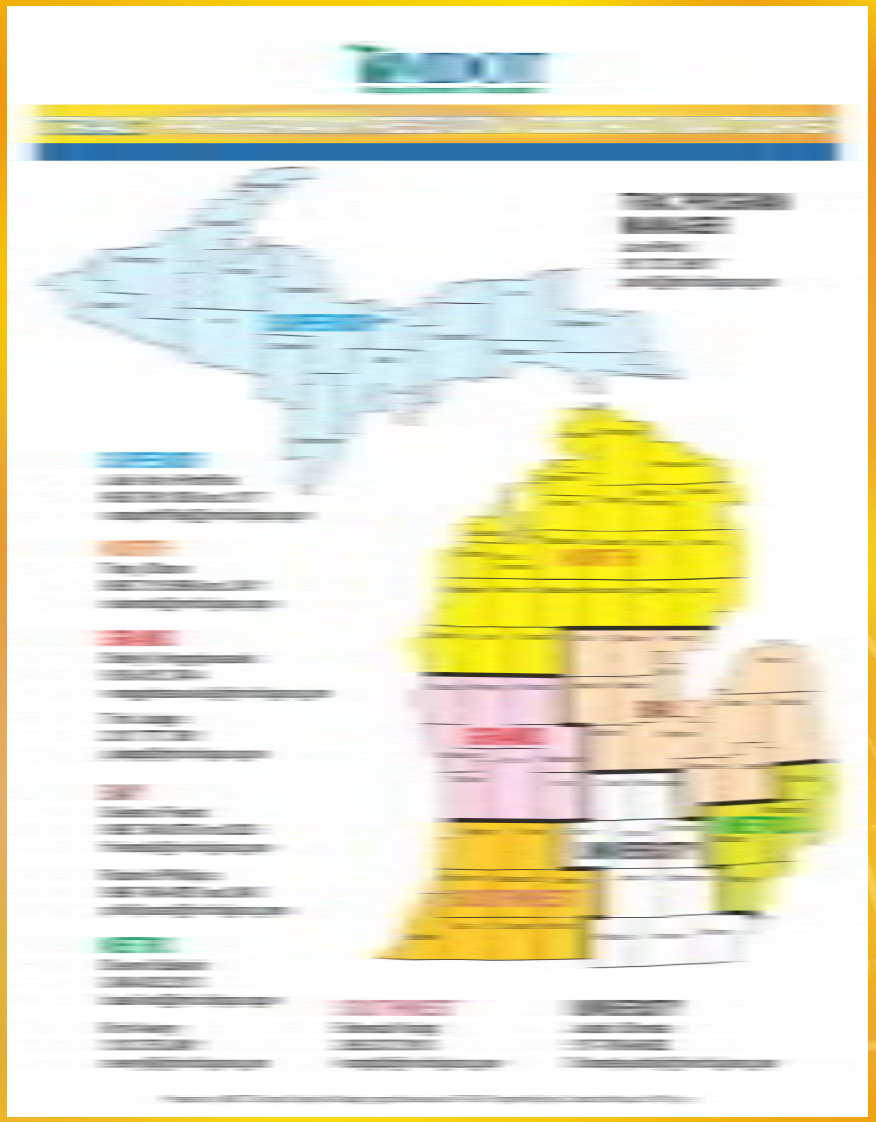
TRANSPORTATION AND CIVIL ENGINEERING

- Hands-on education program
- Science, math, and social science classes
- Engages students in solve real-world problems
- Connects middle/high school kids to the working world of transportation
- Inspires them to consider careers in transportation and civil engineering
- Transportation Professionals visit the classroom

TRAC Michigan TRAC Background

TRANSPORTATION AND CIVIL ENGINEERING

- Started in 2004
- Many Schools involved
- Many Teachers trained



TRAC 8 TRAC Modules

TRANSPORTATION AND CIVIL ENGINEERING

Bridge Builder Module

Environmental Module

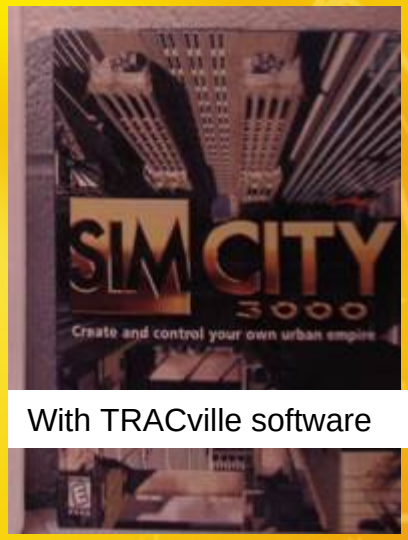
Safety Module

Maglev Module

Technology Module

Motion Module

Design and Construction Module



With TRACville software

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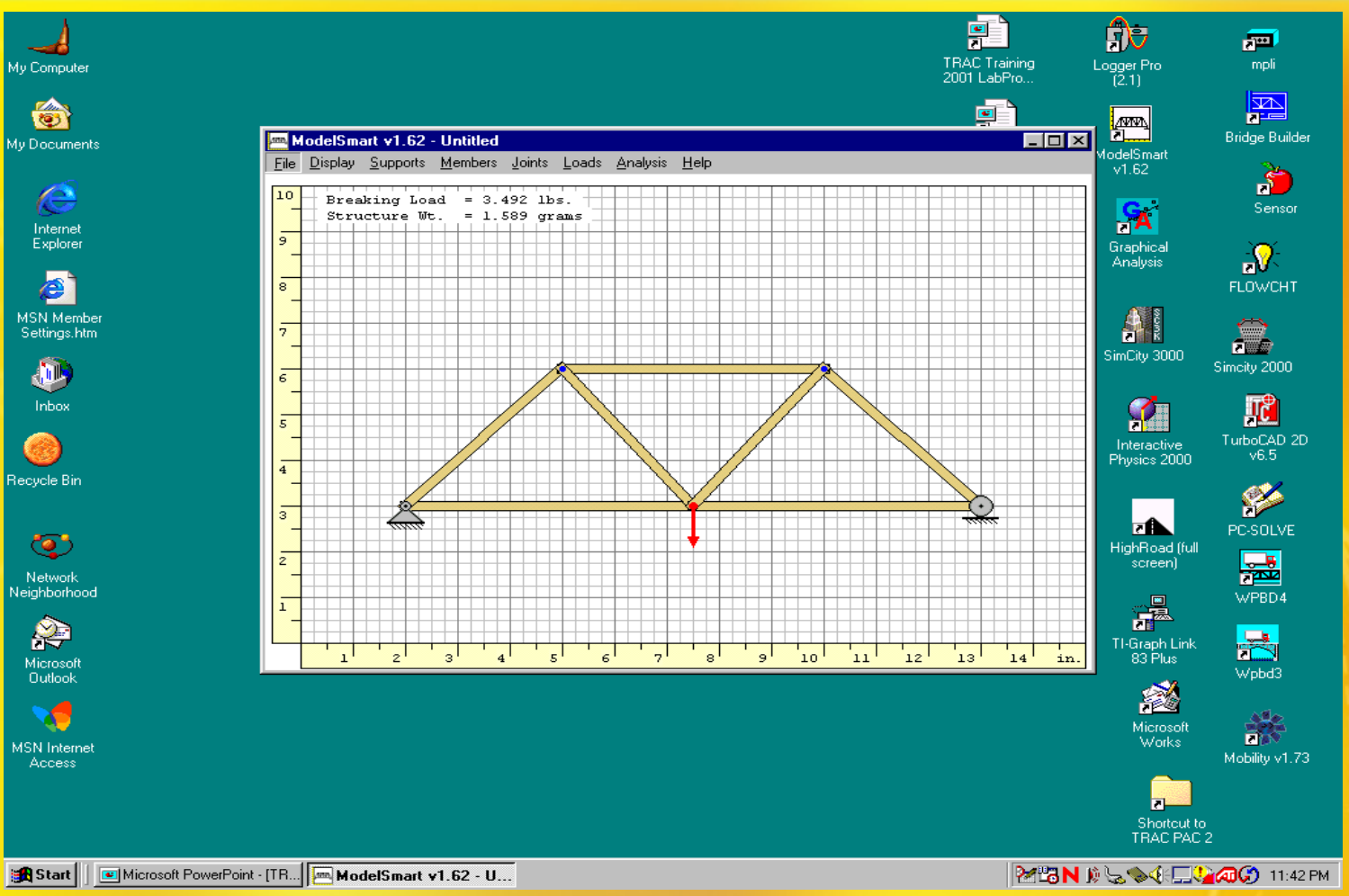
Bridge Builder

TRANSPORTATION AND CIVIL ENGINEERING

- The bridges are designed and built by the students, and then tested to judge the performance of the bridges
- Inter- and intra-school bridge building competitions give students a chance to test their skills as bridge designers

TRAC Bridge Builder

TRANSPORTATION AND CIVIL ENGINEERING



TRAC City Planning/SIM CITY

TRANSPORTATION AND CIVIL ENGINEERING

- **Students will learn how to improve a city with zoning and transportation problems**
- **Work in teams to decide where to build roads, place utilities, and which neighborhoods to zone as industrial, commercial or residential**
- **Meet the challenges of cost, time, and potential natural disasters all while improving their citizen's quality of life**

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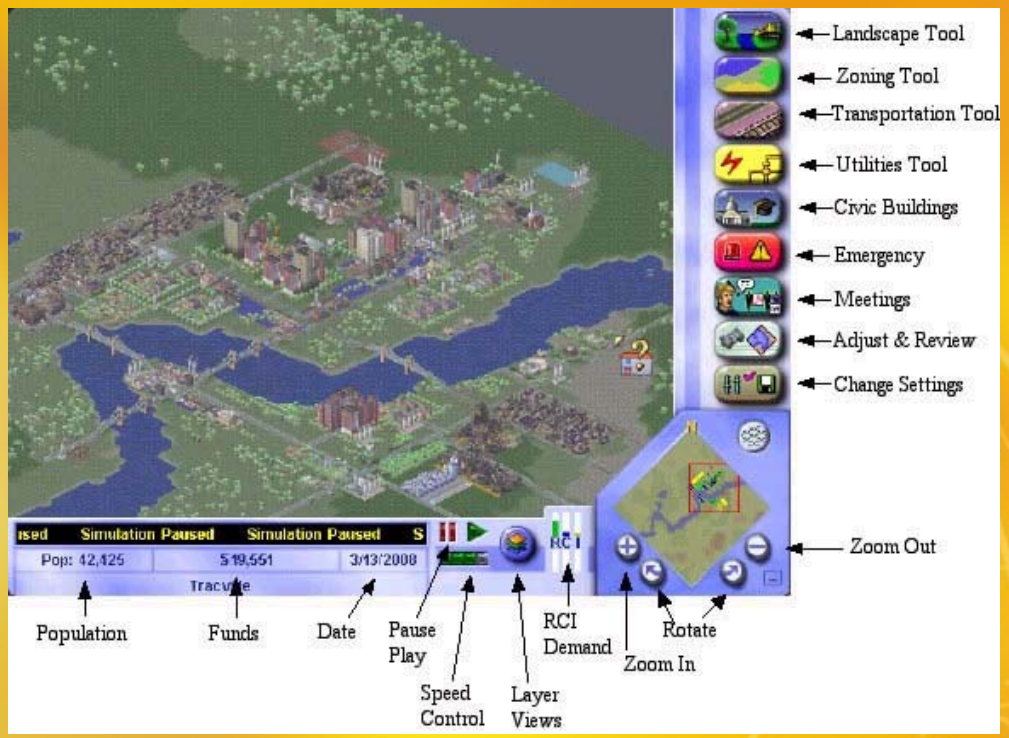
City Planning/SIM CITY

TRANSPORTATION AND CIVIL ENGINEERING

- Concepts of design
- Problem solving
- Critical thinking
- Group decision making



Highway Development & the Environment

- **Students discover particle sedimentation rates and the effectiveness of different materials to filter muddy water, while also learning about managing erosion in construction areas**
- **Students introduced to highway and city planning while they consider air and water quality, sound pollution, and habitat loss**
- **Students study the impact of a new highway on their community and present their solutions to the community for "vote" of approval, in a mock hearing**

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Highway Safety

TRANSPORTATION AND CIVIL ENGINEERING

- **Review of the basic methods of identifying problems, determining the reliability and validity of data, and choosing the most effective solution**
- ***MSC.Software Corporation's Interactive Physics* education software is used to illustrate the results of a vehicle hitting either another vehicle or a fixed object**
- **Variables such as size, mass, friction, speed, force, and energy absorption are all explored**

Highway Safety

- Addresses a number of issues related to the determination of local safety problems, to identifying and prioritizing high-accident locations, and, on a limited budget, trying to fix them

- Also illustrates the physics involved in traffic crashes, including the effects of the first collision as it relates to the conservation of momentum and the impact of mass and velocity on the effectiveness of crash impact attenuators

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Magnetic Levitation

TRANSPORTATION AND CIVIL ENGINEERING

- Students learn to identify the human factors that can lead to measurement errors
- Middle school students learn the basics of graphing while measuring time and calculating velocity of a MagLev car, and then collect data on acceleration rates
- High school students relate line slope to velocity, graph collected data, and verify Newton's Second Law by interpreting their graph
- A design/build competition gives students a chance to put what they have learned to the test – against the clock and each other

Motion & the Transportation Engineer

- **Momentum- students investigate momentum in relation to traffic collisions**
  - **Magnetic levitation cars are used to illustrate the effects of a collision, help students analyze collisions, and compute conservation of energy**
  - **Students use lab equipment to design their own system for measuring speed**

- **Impulse- demonstrations and lab work illustrate the effect distance has on the force applied to a car on impact**
  - **Eggs help students understand the influence of distance on force**
  - **Using a pendulum, students see the impact a change in direction has in a collision**
  - **What's the best way to stop a moving vehicle? Students experiment w/ various barrier components to find out**

Roadway Design & Construction

- Road capacity, design consequences, budgets, and environmental impact all must be considered when students are asked to design and build a new roadway
- Using spreadsheets and computer-based modeling, students estimate real estate prices for the land that must be bought for the roadway
- Students delve into the underlying mathematics of road design using High Roads CAD software to create a road and explore curves

Roadway Design & Construction

- Students are introduced to the Intelligent Transportation System (ITS) concepts of sensors, traffic management systems, and software engineering through a computer programming exercise in visual basic for Applications
- Transportation topics include horizontal curvature, traffic flow and capacity relationships used within traffic engineering, determining the “best” road location to acquire right of way, and traffic management systems
- Teachers may elect to do all, some, or none of the five activities in this module; they are suitable for groups of 2-4 students and diversity within the group is recommended; e.g. an artist, an organizer, and a technical expert

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Traffic Technology

TRANSPORTATION AND CIVIL ENGINEERING

- By calculating reaction time and braking distance, students study linear motion while strengthening calculation skills
- Students calculate the timing sequence of a traffic light using collected data
- Using spreadsheets, students build a traffic light logic sequence while learning basic computer programming
- In a hands-on research project, students explore the physics concepts used to design the mechanism that changes a traffic signal from red to green

Traffic Technology

- **Covers the topics of basic linear motion, basic circuits and Boolean logic as taught in an intermediate school general science course or a high school physics/computer course**

- **The understanding of these concepts is fundamental to the transportation topics of highway safety and design**

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Free TRAC Materials

TRANSPORTATION AND CIVIL ENGINEERING

- Hands-on materials for math, science, and social sciences
- Interactive software
- Training
- Activities aligned to Michigan Education Standards

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MI Education Standards-Math/Science

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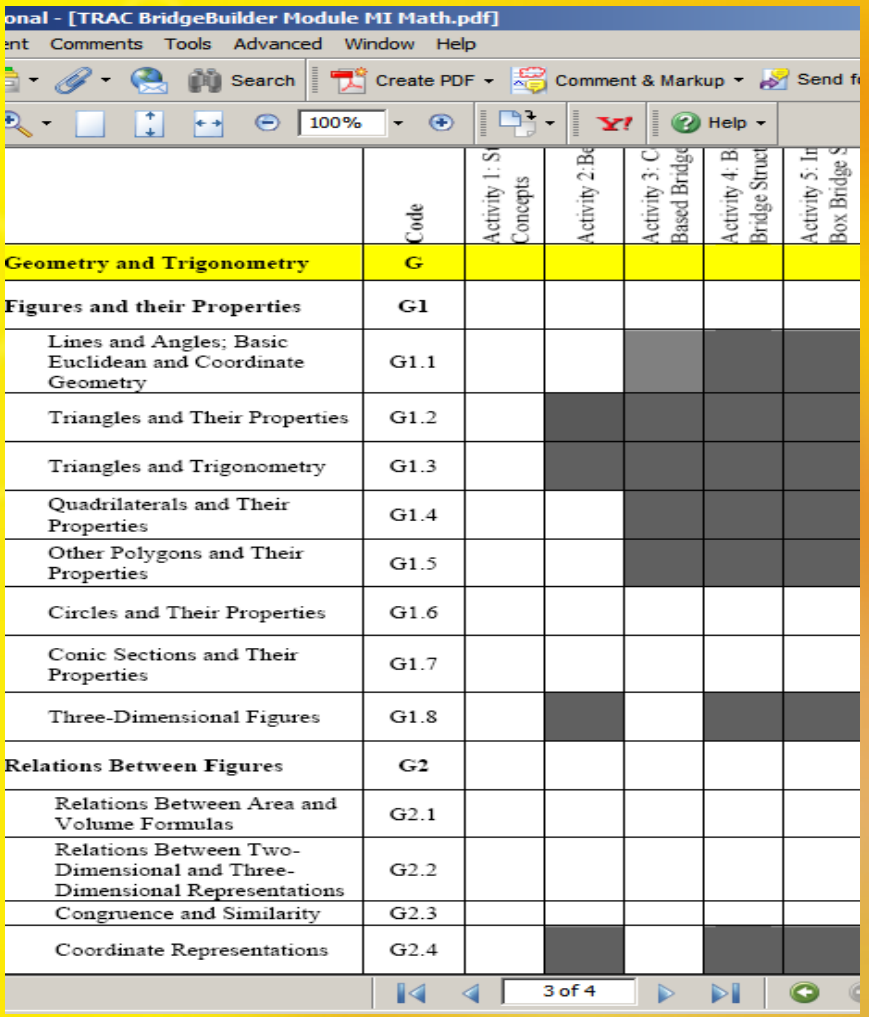

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	Code	Activity 1: St Concepts	Activity 2: Be	Activity 3: C Based Bridge	Activity 4: B Bridge Struct	Activity 5: In Box Bridge S
Geometry and Trigonometry	**G**					
Figures and their Properties	**G1**					
Lines and Angles; Basic Euclidean and Coordinate Geometry	G1.1					
Triangles and Their Properties	G1.2					
Triangles and Trigonometry	G1.3					
Quadrilaterals and Their Properties	G1.4					
Other Polygons and Their Properties	G1.5					
Circles and Their Properties	G1.6					
Conic Sections and Their Properties	G1.7					
Three-Dimensional Figures	G1.8					
Relations Between Figures	**G2**					
Relations Between Area and Volume Formulas	G2.1					
Relations Between Two-Dimensional and Three-Dimensional Representations	G2.2					
Congruence and Similarity	G2.3					
Coordinate Representations	G2.4					

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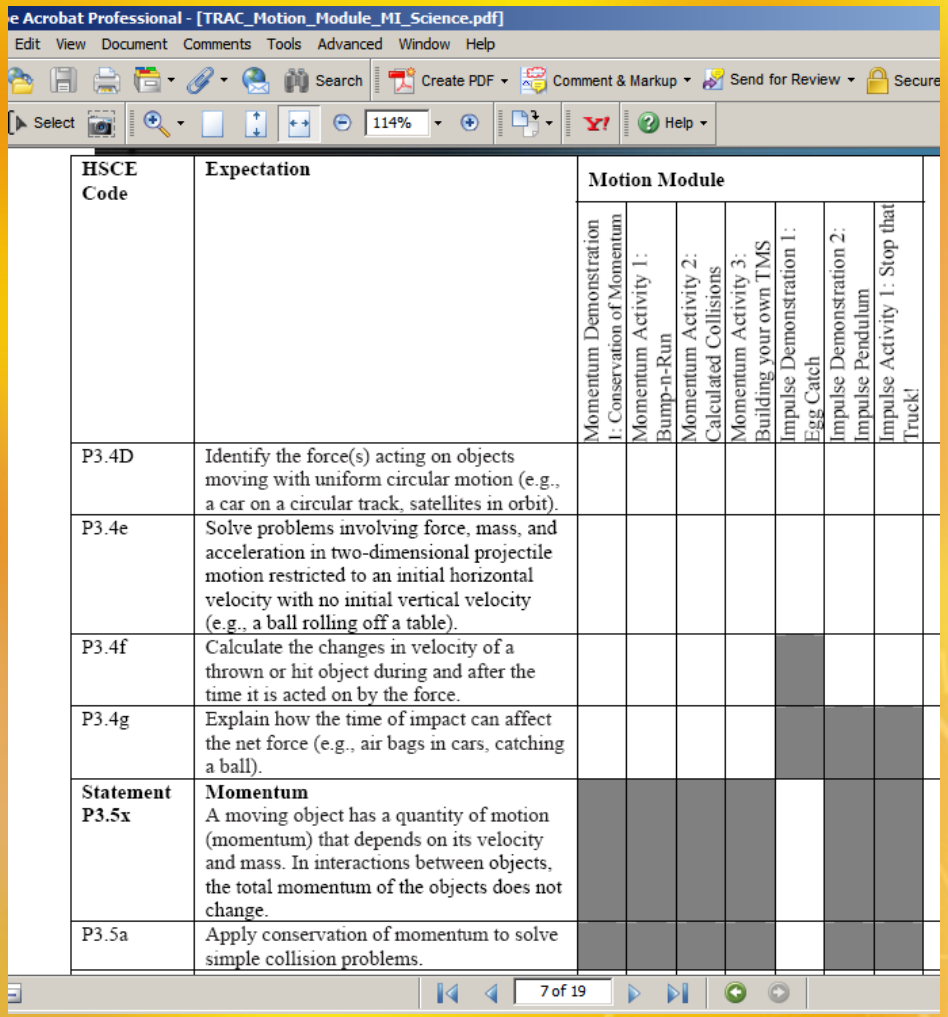

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HSCE Code	Expectation	Motion Module						
		Momentum Demonstration 1: Conservation of Momentum	Momentum Activity 1: Bump-n-Run	Momentum Activity 2: Calculated Collisions	Momentum Activity 3: Building your own TMS	Impulse Demonstration 1: Egg Catch	Impulse Demonstration 2: Impulse Pendulum	Impulse Activity 1: Stop that Truck!
P3.4D	Identify the force(s) acting on objects moving with uniform circular motion (e.g., a car on a circular track, satellites in orbit).							
P3.4e	Solve problems involving force, mass, and acceleration in two-dimensional projectile motion restricted to an initial horizontal velocity with no initial vertical velocity (e.g., a ball rolling off a table).							
P3.4f	Calculate the changes in velocity of a thrown or hit object during and after the time it is acted on by the force.							
P3.4g	Explain how the time of impact can affect the net force (e.g., air bags in cars, catching a ball).							
Statement P3.5x	**Momentum** A moving object has a quantity of motion (momentum) that depends on its velocity and mass. In interactions between objects, the total momentum of the objects does not change.							
P3.5a	Apply conservation of momentum to solve simple collision problems.							

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Available on www.michigan.gov/mdot-trac

Companion Programs

- Michigan Bridge Building Challenge
- Pipeline Summer Internships
  - 12th Grade Graduating Senior
  - 11th Grade **Pilot** Program

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Bridge Challenge

TRANSPORTATION AND CIVIL ENGINEERING

- Challenge
  - 7 & 8 Grades – Drawbridge
  - 9 & 10 Grades – Floating Bridge
  - 11 & 12 Grades – Suspension Bridge
- Prizes
  - 1st $600.00 team prize
  - 2nd $375.00 team prize
  - 3rd $225.00 team prize
  - 4th $150.00 team prize

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TRACOG
Michigan Design & Build Bridge Challenge


Rob
Whaley


Michigan Design & Build Bridge Challenge
MDOT
michigan.gov/recove

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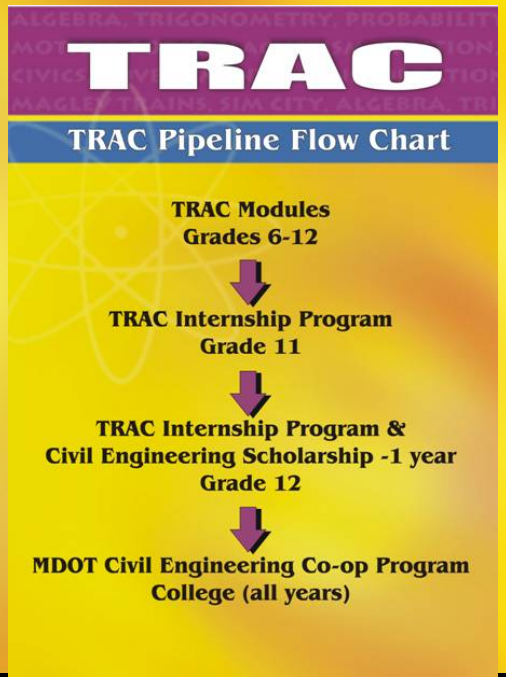
TRANSPORTATION AND CIVIL ENGINEERING

TRAC Pipeline

Summer Internship Program



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TRAC Asphalt Sampling, Soil Boring

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QUESTIONS?

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MDOT TRAC Website

www.michigan.gov/mdot-trac