TRUMBULL PUBLIC SCHOOLS

Trumbull, Connecticut

TRANSPORTATION ENGINEERING TECHNOLOGY
Grades 9-12
Technology Education Department

2019

Curriculum Writing Team

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Transportation Engineering Technology
Grades 9-12
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CORE VALUES AND BELIEFS

The Trumbull High School community engages in an environment conducive to learning which believes that all students will **read and write effectively**, therefore communicating in an articulate and coherent manner. All students will participate in activities **that present problem-solving through critical thinking**. Students will use technology as a tool applying it to decision making. We believe that by fostering self-confidence, self-directed and student-centered activities, we will promote **independent thinkers and learners**. We believe **ethical conduct** to be paramount in sustaining the welcoming school climate that we presently enjoy.

Approved 8/26/2011

INTRODUCTION & PHILOSOPHY

Transportation is much more than the typical cars, planes, and boats everyone always thinks of. In the modern world where technology is always changing, so are the ways we move. There is a lot more to transportation these days besides internal combustion engines powering vehicles. There are electric cars, Segways, even maglev trains capable of traveling 300mph. Even the way we communicate has advanced from snail mail and floppy disks, to text messages and e-mails.

Transportation Engineering Technology allows students to study a cross-section of transportation technology topics, including the vehicles and infrastructure systems needed to move people and goods. Students will explore the areas of land, marine, and air transportation and their social, environmental, and economic impact. Students will research and use engineering concepts to construct projects that relate to each form of transportation. Possible projects include scale-model boats, hovercrafts, gliders, CO_2 dragsters, and more. Alternative energy transportation systems and power systems are investigated as part of the overall picture of transportation.

COURSE GOALS

The following course goals derive from the 2014 Connecticut Technology Education Standards.

ENG.02	Use the design process to solve problems by creating and refining prototypes.
ENG.03	Ensure quality control using the major components of manufacturing processes including measurement systems, tools, and instruments to produce a product.
ENG.05	Works collaboratively in engineering teams throughout the design process.
ENG.06	Use engineering equipment, laboratory materials, and tools appropriately and safely.
TRAN.01	Identify how historical, social, economic, environmental, and government regulations impact transportation technology.
TRAN.02	Define transportation technology systems.

The following course goals derive from the 2010 Connecticut Core Standards.

CCS.MP.4	Model with mathematics.
CCS.MP.5	Use appropriate tools strategically.
CCS.HSG-GMD.4	Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two- dimensional objects.

The following course goals derive from the 2016 International Society for Technology in Education Standards.

ISTE Innovative Designer (Standard 4)	Students use a variety of technologies within a design process to identify and solve problems by creating new, useful, or imaginative solutions.
ISTE Computational Thinker (Standard 5)	Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

COURSE ENDURING UNDERSTANDINGS

Students will understand that . . .

- each mode of transportation couldn't function without specific types of permanent infrastructure.
- safety in technology labs is required of everyone.
- respect, attention to detail, and critical thinking are top priorities for great results.
- many transportation engineering projects are interdisciplinary and require pulling knowledge and skills from various areas.

COURSE ESSENTIAL QUESTIONS

- What is transportation?
- What are the four modes of transportation?
- What is a vehicle?
- What are the positive and negative aspects of a transportation mode?
- How has the progression of transportation methods changed how we live?
- How do scientific principles relate to the different modes of transportation?
- How can something heavier than air fly?
- Why is it important to know about dimensions and scale?
- What are the expenses associated with each mode of transportation?

COURSE KNOWLEDGE & SKILLS

Students will know . . .

- how permanent infrastructures allow vehicles to function.
- Archimedes' discovery and how it affects our everyday lives.
- the numeric representation of interstate direction.

Students will be able to . . .

- follow step-by-step assembly directions related to transportation engineering technology.
- safely and accurately use a drill press.
- safely and accurately use a bandsaw.
- read and correctly use a 1/16" scale ruler.

COURSE SYLLABUS

Course Name

Transportation Engineering Technology

Level

Grades 9-12

Prerequisites

None

Materials Required

None

General Description of the Course

This course allows students to study a cross-section of transportation technology topics, including the vehicles and infrastructure systems needed to move people and goods. Students will explore the areas of land, marine, and air transportation and their social, environmental, and economic impact. Students will research and use engineering concepts to construct projects that relate to each form of transportation. Possible projects include scale-model boats, hovercrafts, gliders, CO_2 dragsters, and more. Alternative energy transportation systems and power systems are investigated as part of the overall picture of transportation.

Assured Assessments

- Written assessment based on lab safety procedures (Unit 1)
- Creation of a basic drawing (Unit 2)
- Quizzes on unit material (Units 2, 4, 5, 6)
- In-class discussions (Unit 3)
- Build a Barge Project (Unit 4)
- Super Delta Dart Project (Unit 5)
- Building a Tissue Paper Hot Air Balloon Project (Unit 5)
- CO_2 Dragster Project (Unit 6)

UNIT 1
General Lab Safety

Unit Goals

At the completion of this unit, students will:

ENG.06 Use engineering equipment, laboratory materials, and tools appropriately and safely.

Unit Essential Questions

- Why is it important that everyone understands and follows the safety procedures in and around the lab?
- What do I need to know in an emergency situation in the lab?
- What are the different types of Personal Protective Equipment (PPE)?

Scope and Sequence

1. Emergency power shut-offs
2. Fire drill procedures
3. Stay-put procedures
4. Lockdown procedures
5. First Aid kit
6. Eyewash / Shower station
7. Personal Protective Equipment (PPE)
8. Material Data Safety Sheets (MSDS)

Assured Assessments

- Written assessment based on specific lab safety procedures for the class

Resources

Supplemental

- Note-taking sheets related to safety procedures
- Power Tool Institute, Inc. *Power Tool Accidents – They Can Be Prevented*. https://www.powertoolinstitute.com/pti-pages/videos/safetyvideo_1_powertoolaccidents_eng-youtube.asp. Web.

Time Allotment

- Approximately ½ week

UNIT 2
Measurement

Unit Goals

At the completion of this unit, students will:

ENG.03 Develop the ability to measure accurately to a sixteenth of an inch and to explain and use fractional dimensions.

CCS.MP.4 Model with mathematics.

CCS.MP.5 Use appropriate tools strategically.

Unit Essential Questions

- Why do I need to be able to read a ruler?
- Why is it important to reduce fractions to their lowest terms?
- Why is it important to understand how measurements are scaled?

Scope and Sequence

1. Measuring to the nearest 1/16", 1/8", ¼", ½", with a large-scale model of an inch as a visual
2. Converting inches to feet and feet to inches
3. Greatest Common Divisor: Dividing numerator and denominator by the greatest common divisor
4. Scale of measurement in a plan/drawing

Assured Assessments

- Creation of a basic drawing following specific measurements using a ruler and a straightedge
- Quiz on unit material

Resources

<u>Core</u>

- Note-taking sheets related to measuring procedures
- Measuring worksheet

<u>Supplemental</u>

- Online ruler reading game: from whole, to half, all the way down to sixteenth scale

Time Allotment

- Approximately ½ week

UNIT 3
Introduction to Transportation

Unit Goals

At the completion of this unit, students will:

TRAN.01 Identify how historical, social, economic, environmental, and government regulations impact transportation technology, including how transportation systems maintain our quality of life.

TRAN.02 Define transportation technology systems, including basic applications of transportation technology (e.g., moving people, transporting goods, and recreation).

Unit Essential Questions

- What are the four areas of transportation?
- What are different modes of transportation?
- How does infrastructure differ among the areas of transportation, and how does the infrastructure of each work?
- What are positive and negative impacts of transportation?

Scope and Sequence

1. Marine, air, land, and space transportation
2. Automobiles, bicycles, trains, balloons, prop-driven aircrafts, helicopters, barges, tugboats, sailboats, single-stage rockets, multi-stage rockets
3. Ports, lighthouses, buoys, drawbridges, runways, terminals, air traffic controls, roads, sidewalks, street signs, bus stops, railroad crossings, rail yards, signage, launch facilities, command centers, etc.
4. Pollutants, noise, accidents, energy consumption, stress, cost; ability to move quickly, with high reliability, reaching remote places, economical, with low cost of maintenance, providing international transport

Assured Assessments

- In-class discussions about infrastructures students have seen on their way to school, and how they affected their routes to school (e.g., how a route might change if a bridge were closed, or if a traffic light didn't exist, etc.)
- Project

Resources

<u>Core</u>

- Visual presentations and digital clips
- Worksheets

Supplemental

- Guided note-taking sheets

Time Allotment

- Approximately 2 weeks

UNIT 4
Marine Transportation

Unit Goals

At the completion of this unit, students will:

ENG.02 ENG.05 ISTE Innovative Designer (Standard 4)	Brainstorm possible solutions, and test marine transportation prototypes to defined criteria.
TRAN.02 ENG.05 ISTE Computational Thinker (Standard 5)	Solve a simple marine transportation problem by designing, building, and testing a vehicle that will carry a payload a specified distance.

Unit Essential Questions

- What are the major parts of a boat?
- What are the different hull designs?
- How do the parts of a sailboat work together?
- How does Archimedes' Principle relate to buoyancy?
- How can an object become more buoyant?

Scope and Sequence

1. Hull, bow, stern, port, starboard, transom, keel, rudder
2. Types of hulls
   a. Displacement hulls: Semi-V, Deep-V, cathedral
   b. Planing hulls: flat-bottom, catamaran, hydroplane
3. Mast and boom supporting the main sail, while mast supports the jib sail. Main sail is the primary source of sailpower, while jib sail is a smaller headsail.
4. Archimedes' discovery that an object immersed in fluid loses weight equal to the weight of the fluid it displaces
5. Density, volume, shape, etc.

Assured Assessments

- Written quiz aligning with teacher-presented information
- Preliminary Build a Barge Project prototype
- Redesigned Build a Barge Project prototype to improve upon original design

Resources

Core

- Visual presentations and digital clips
- Worksheets

Supplemental

- Guided note-taking sheets

Time Allotment

- Approximately 3 weeks

UNIT 5
Air Transportation

Unit Goals

At the completion of this unit, students will:

TRAN.01	Explain historical innovations in the evolution of air transportation systems, including how government regulations impact air transportation.
ENG.02 ENG.05 ISTE Innovative Designer (Standard 4) ISTE Computational Thinker (Standard 5)	Demonstrate understanding of the application of propulsion, control, guidance, payload, and support systems for air transportation.

Unit Essential Questions

- How has the history of manned aircraft evolved?
- What are the different kinds of air vehicles?
- How does a wing's shape allow it to fly?
- How does the government affect air travel?

Scope and Sequence

1. The Wright brothers' first successful powered flight in 1903 in Kitty Hawk, NC
2. Types of air vehicles
   a. Lighter-than-air vehicles: air balloons, dirigibles
   b. Heavier-than-air vehicles: airplanes, helicopters, gyrocopters, hybrids
3. Bernoulli's Principle, forces of flight, airplane control parts (ailerons, rudders, elevators)
4. Federal Aviation Administration

Assured Assessments

- Written quiz aligning with teacher-presented information
- Super Delta Dart model airplane: individual kit for balsa wood propeller-powered airplane
- Building a Tissue Paper Hot Air Balloon Project

Resources

<u>Core</u>

- Visual presentations and digital clips
- Worksheets

Supplemental

- Guided note-taking sheets

Time Allotment

- Approximately 5 weeks

UNIT 6
Land Transportation

Unit Goals

At the completion of this unit, students will:

ENG.02 ENG.05 ISTE Innovative Designer (Standard 4)	Demonstrate understanding of the components of the design process: define the problem, brainstorm, research, develop solutions, prototype, test/evaluate, and communicate results.
ENG.02 ENG.05 ISTE Computational Thinker (Standard 5)	Demonstrate understanding of the application of propulsion, control, guidance, payload, and support systems for land transportation.
TRAN.02	Define and properly use land transportation technology terminology.
CCS.HSG-GMD.4 ENG.05	Identify the shapes of two-dimensional cross-sections of three dimensional objects, and identify three-dimensional objects generated by rotations of two- dimensional objects.

Unit Essential Questions

- How have roadways in the United States evolved over the years?
- What do the interstate numbers mean?
- What are tasks that aerodynamics must perform?
- How do aerodynamics affect a moving object?

Scope and Sequence

1. Dwight Eisenhower, Federal Aid Highway Act, 1956
2. Primary/auxiliary interstates: north/south=odd; east/west=even
3. Stability, performance, cooling, comfort
4. Drag, frontal area, vehicle shape, wind tunnel testing

Assured Assessments

- Written quiz aligning with teacher-presented information
- CO_2 Dragster Project

Resources

Core

- Visual presentations and digital clips
- Worksheets

Supplemental

- Guided note-taking sheets

Time Allotment

- Approximately 6 weeks

COURSE CREDIT

One-half credit in technology education
One class period daily for a half year

PREREQUISITES

None.

CURRENT REFERENCES

- Roth, Alfred C. *Small Gas Engines*. Tinley Park, IL: Goodheart-Willcox, 2004. Print.
- https://www.howstuffworks.com/. Web.
- https://themathworksheetsite.com/. Web.
- https://www.youtube.com/. Web.

ASSURED STUDENT PERFORMANCE RUBRICS

- Trumbull High School School-Wide Problem-Solving through Critical Thinking Rubric (attached)
- Trumbull High School School-Wide Social & Civic Expectations Rubric (attached)
- Trumbull High School School-Wide Independent Learning and Thinking Rubric (attached)
- Transportation Engineering Technology Build a Barge Project (attached)
- Transportation Engineering Technology Super Delta Dart Rubric (attached)
- Transportation Engineering Technology Building a Tissue Paper Hot Air Balloon Project and Rubric (attached)
- Transportation Engineering Technology CO_2 Dragster Project and Rubric (attached)

Trumbull High School School-Wide
Problem-Solving through Critical Thinking Rubric

Category/ Weight	Exemplary 4 Student work:	Goal 3 Student work:	Working Toward Goal 2 Student work:	Needs Support 1-0 Student work:
Understanding X_____	Student demonstrates clear understanding of the problem and the complexities of the task.	Student demonstrates sufficient understanding of the problem and most of the complexities of the task.	Student demonstrates some understanding of the problem but requires assistance to complete the task.	Student demonstrates limited or no understanding of the fundamental problem after assistance with the task.
Research X_____	Student gathers compelling information from multiple sources including digital, print, and interpersonal.	Student gathers sufficient information from multiple sources including digital, print, and interpersonal.	Student gathers some information from few sources including digital, print, and interpersonal.	Student gathers limited or no information.
Reasoning and Strategies X_____	Student demonstrates strong critical thinking skills to develop a comprehensive plan integrating multiple strategies.	Student demonstrates sufficient critical thinking skills to develop a cohesive plan integrating strategies.	Student demonstrates some critical thinking skills to develop a plan integrating some strategies.	Student demonstrates limited or no critical thinking skills and no plan.
Final Product and/or Presentation X_____	Solution shows deep understanding of the problem and its components. Solution shows extensive use of 21st-century technology skills.	Solution shows sufficient understanding of the problem and its components. Solution shows sufficient use of 21st-century technology skills.	Solution shows some understanding of the problem and its components. Solution shows some use of 21st-century technology skills.	Solution shows limited or no understanding of the problem and its components. Solution shows limited or no use of 21st-century technology skills.

Trumbull High School School-Wide
Social & Civic Expectations Rubric

Category/ Weight	Exemplary 4	Goal 3	Working Toward Goal 2	Needs Support 1-0
Responsibility for Self X_____	• Highly self-directed • Consistently displays ethical conduct in the classroom and on campus	• Self-directed • Displays ethical conduct in the classroom and on campus	• Occasionally self-directed • At times displays ethical conduct in the classroom and on campus	• Rarely self-directed • Seldom displays ethical conduct in the classroom and on campus
Respects Others X_____	• Sensitive and considerate to others	• Considerate to others	• At times considerate to others	• Insensitive to others
Practices Interpersonal Skills X_____	• Champions discussions to resolve differences through active listening and offers opinions without prompting in a positive and rational manner	• Actively discusses avenues to resolve differences when appropriate, and offers encouraging opinions when prompted	• At times, appears indifferent to others, does not seek avenues to resolve differences, and is inflexible in his or her own opinions	• Demonstrates intolerance and lacks social interaction skills
Cultural Understanding X_____	• Demonstrates a high level of cultural understanding and respect for the uniqueness of others, their practices and perspectives	• Demonstrates an appreciation of cultural understanding and respect for the uniqueness of others, their practices and perspectives	• Demonstrates little appreciation of cultural understanding and respect for the uniqueness of others, their practices and perspectives	• Demonstrates a lack of appreciation of cultural understanding and respect for the uniqueness of others, their practices and perspectives

Trumbull High School School-Wide
Independent Learning and Thinking Rubric

Category/Weight	Exemplary 4	Goal 3	Working Toward Goal 2	Needs Support 1-0
Proposal X_____	Student demonstrates a strong sense of initiative by generating compelling questions, creating uniquely original projects/work.	Student demonstrates initiative by generating appropriate questions, creating original projects/work.	Student demonstrates some initiative by generating questions, creating appropriate projects/work.	Student demonstrates limited or no initiative by generating few questions and creating projects/work.
Independent Research & Development X_____	Student is analytical, insightful, and works independently to reach a solution.	Student is analytical, and works productively to reach a solution.	Student reaches a solution with direction.	Student is unable to reach a solution without consistent assistance.
Presentation of Finished Product X_____	Presentation shows compelling evidence of an independent learner and thinker. Solution shows deep understanding of the problem and its components. Solution shows extensive and appropriate application of 21st Century Skills.	Presentation shows clear evidence of an independent learner and thinker. Solution shows adequate understanding of the problem and its components. Solution shows adequate application of 21st Century Skills.	Presentation shows some evidence of an independent learner and thinker. Solution shows some understanding of the problem and its components. Solution shows some application of 21st Century Skills.	Presentation shows limited or no evidence of an independent learner and thinker. Solution shows limited or no understanding of the problem. Solution shows limited or no application of 21st Century Skills.

TRANSPORTATION ENGINEERING TECHNOLOGY
BUILD A BARGE PROJECT

Objective: To design and build a device that will float as many pennies as possible.

Prior to constructing your barge you are required to brainstorm a design, and draw a dimensioned sketch of your idea that you will follow during the fabrication process.

Rules:

1. You will be given the following construction supplies:
   a. 2 pieces of 6"x6" aluminum foil
   b. 8 plastic drinking straws
   c. 18 inches of masking tape

2. You may use all of or part of the construction supplies as needed for your design, but you may not use anything else.

3. Your barge must be constructed to fit within the test tank.

4. Your barge must be completed within the time limit set by the teacher, and all construction must be done in class.

5. Each barge will be floated in a test tank. Pennies will be placed one at a time on the barge until the barge TOTALLY sinks.

6. The barge that holds the most pennies will be declared the winning design.

TRANSPORTATION ENGINEERING TECHNOLOGY
SUPER DELTA DART RUBRIC

Period: _____ Prepared by: _____

Describe the project: _____

_____

_____

_____

_____

_____

	Student Comments	Student Grade	Teacher Comments	Teacher Grade
Planning and Layout: The template was followed and measured correctly. (10 points)				
Cutting and Fitting Material: The correct material was used, and it was cut accurately. (10 points)				
Fastening and Gluing: The plane is glued together well, securely fastened, and measured accurately. (15 points)				
Craftsmanship: The wings are straight, the overall appearance is good, etc. (15 points)				

Total Points: _____ / 50

TRANSPORTATION ENGINEERING TECHNOLOGY
BUILDING A TISSUE PAPER HOT AIR BALLOON PROJECT

Objective: To design and build a hot air balloon out of tissue paper that will fly using the same principle as a hot air balloon. *By heating the air inside the balloon to a warmer temperature than the cooler air around it, the hot air will rise, causing the balloon to float. As the warm air supply stops, or cools, the balloon will slowly come back down to the ground.*

Prior to constructing your balloon you are required to brainstorm and build a three-dimensional model design that you will follow during the fabrication process.

Rules:

1. You will be given the following construction supplies:
   a. 14 pieces of tissue paper
   b. 2 glue sticks

2. You may use all of or part of the construction supplies as needed for your design, but you may not use anything else.

3. There will be rulers, scissors, and a paper cutter to use during the assembly process.

4. We will be launching the balloons from a 4”-diameter launch tube, so the design must include a minimum circular opening of 4”.

5. If built correctly and filled with enough hot air, all of the balloons should fly well above the height of the school building.

TRANSPORTATION ENGINEERING TECHNOLOGY
BUILDING A TISSUE PAPER HOT AIR BALLOON RUBRIC

Period: _____ Prepared by: _____

Describe the project: _____

_____

_____

_____

_____

_____

	Student Comments	Student Grade	Teacher Comments	Teacher Grade
Planning and Layout: The drawing template was followed and measured correctly. (10 points)				
Cutting and Fitting Material: The correct material was used, and it was cut accurately. (10 points)				
Fastening and Gluing: The balloon is glued together well, and securely fastened, with no open seams. (15 points)				
Craftsmanship: The overall appearance is good, and the balloon flies as expected. (15 points)				

Total Points: _____ / 50

TRANSPORTATION ENGINEERING TECHNOLOGY
CO_2 DRAGSTER PROJECT

Objective: Working individually using Internet sources, you will find three CO_2 dragster / CO_2 car designs you like. You should compile your three pictures and descriptions in a Word document, including:

- A small picture of each of the three designs.
- What specific part of each design you like, and why.

These won't necessarily have to be exact versions of what you want your own car to look like, but I want you to get multiple ideas so you can use bits and pieces of different design ideas to create your final design. When you're done, be sure to print your document with your name on it.

The following area is where your project design can be illustrated. It needs to be detailed and must include dimensions so we know the overall size and shape of your car, as we talked about yesterday while reading the "Intro Handbook."

Side View	
Front View	Top View

TRANSPORTATION ENGINEERING TECHNOLOGY
CO_2 DRAGSTER PROJECT RUBRIC

Period: _____ Prepared by: _____

Describe the project: _____

_____

_____

_____

_____

_____

	Student Comments	Student Grade	Teacher Comments	Teacher Grade
Planning and Layout: The drawing is detailed and matches the finished product. (10 points)				
Cutting and Shaping: The wooden dragster is cut accurately and sanded smoothly. (15 points)				
Axle Hole (from bottom of car): Between 3/16" and 7/16". (5 points)				
Axle Hole (from ends of body): Between 3/8" and 3-15/16". (5 points)				
Dragster Body Length: Between 7-7/8" and 12". (5 points)				
Dragster Body Width at Axle Holes: Between 1-3/8" and 1-5/8". (5 points)				
Wheelbase: Between 4-1/8" and 10-5/8". (5 points)				
Craftsmanship: The dragster is free of defects, the overall appearance is good, etc. (15 points)				

Total Points: _____ / 65