

Junior Solar Sprint 8-Week Syllabus



WEEK 1

JSS PROGRAM INTRODUCTION AND BASICS OF VEHICLE DESIGN

- Alternative Energy and Junior Solar Sprint (JSS): show videos
 - 300 Years of Fossil Fuels in 300 Seconds
www.youtube.com/watch?v=cJ-J91SwP8w
 - Thayer School of Engineering at Dartmouth
www.youtube.com/watch?v=lyJKC6A4pGA
 - Bill Nye, why use solar?
www.youtube.com/watch?v=av24fEMhDoU
 - Lesson: [AlternativeEnergy.pdf](#)
- Discuss Hands-on Design and Design Process
 - Relate to professional engineering
 - Relate to work and/or hobbies
 - Lesson: [AlternativeEnergy.pdf](#)
- JSS Schedule
 - School Race approx. date
 - Area Race approx. date
 - Lesson: [AlternativeEnergy.pdf](#)
- Discuss Vehicle Design, Define Goals and Constraints
 - Kit materials
www.pitsco.com/Ray-Catcher-Sprint-Kit
 - Race rules
 - Event Guidelines
www.usaeop.com/jss-resources
 - Vehicle specifications
 - Preliminary Round Model Car
www.usaeop.com/jss-resources
 - Lesson: [CarDesign.pdf](#)
- Discuss vehicle components
 - Chassis: frame which supports all parts
 - Body: not necessary but sometimes helps students visualize vehicle
 - Motor: converts electrical energy into rotary motion
 - Wheels: discs which allow vehicle to roll
 - Axles: rods to which wheels are attached
 - Bearings: support axles and allow them to spin
 - Transmissions: moves rotary motion of motor to wheels as well as reduces motor speed

- Photovoltaic panel: converts sunlight to electric current
- Guidance system: directs vehicle from start gate to finish gate
- Lesson: [CarDesign.pdf](#)
- Student Work
 - Individually brainstorm overall car concepts and sketch them
 - How might your model solar car look?
- Demonstrations and Discussion
 - How do motors make things move?
 - Find examples of machines, toys, vehicles, etc. with mechanical components
 - Come up with lists of questions that need answers before selecting a design
 - Lesson: [CarDesign.pdf](#)

WEEK 2

WHEELS, AXLES, BEARINGS, AND CHASSIS

- Form teams of three students
 - Students share their previously developed individual design concepts with group members
 - Groups combine design concepts into a their initial whole vehicle design.
 - Create new vehicle sketches.
- Weekly Design Review
 - Each team present new vehicle sketches to class.
 - Class suggest questions that need answers before selecting design
- Friction Labs
 - Friction Investigation #2 and #3 pg. 9-11
www.nrel.gov/docs/gen/fy01/30830.pdf
 - Lesson: www.usaeop.com/wp-content/uploads/2015/01/Friction-Investigation1.pdf
- Investigating Materials
 - Investigating-Model-Car-Materials
www.usaeop.com/wp-content/uploads/2015/01/Investigating-Model-Car-Materials.pdf
 - Structure Investigation pg. 16-18
www.nrel.gov/docs/gen/fy01/30830.pdf
 - Lesson: www.usaeop.com/wp-content/uploads/2015/01/Investigating-Model-Car-Materials.pdf

- Ask students to consider the fate of the materials they choose to use to make their vehicles
- Vehicles will be disassembled at the end of the unit and divided into recyclable, reusable and landfill items
- Student Work
 - Build a prototype chassis and mount prototype wheels, axles and bearings
 - Build something that rolls
 - Come up with additional lists of questions to be answered before a design can be selected
 - Continue sketching concepts
- Class discussion
 - Brainstorm list of questions

WEEK 3

MOTORS, TRANSMISSIONS AND SOLAR PANELS

- Demonstrations and Discussion
 - How do motors work?
www.youtube.com/watch?v=d_aTC0iKO68
- Transmission (gear) ratio
www.youtube.com/watch?v=B4j2VPHVm6o
 - Photovoltaics (Solar panels), how do solar panels work?
 - www.youtube.com/watch?v=JOkly6AD0A
 - www.youtube.com/watch?v=UJ8XW9AgUrw
- Class experiments
 - Solar insolation experiment: see effect on voltage produced as panel angle to sun is changed
 - Lesson: www.usaeop.com/wp-content/uploads/2015/01/Suns-Angle-Investigation.pdf
 - Calculate distance traveled per motor revolution (taking into account gear ratio and wheel size)
 - Construct different transmission types and ratios
 - Transmission Investigation pg. 3-7
www.nrel.gov/docs/gen/fy01/30830.pdf
 - Study the effect of wheel diameter on transmission ratios (doolittle.icarus.com/jss)
 - Lesson: www.usaeop.com/wp-content/uploads/2015/01/Transmission-Investigation1.pdf
 - Lesson: www.usaeop.com/wp-content/uploads/2015/01/Transmission-Investigation2.pdf

- Design system for solar panel mounting and angle adjusting
- Class generate design criteria for vehicles
 - Lightweight
 - Sturdy
 - Good acceleration
 - High top speed
 - Low friction
 - bearings
 - gears
 - guidewire
 - Steers straight
 - Can accommodate guide wire
 - Easy to build
 - Aesthetics
 - etc.
- Combine best features from various concepts
- Make working drawing (actual size) of vehicle and bill of materials (spreadsheet)

WEEK 4

SELECT OVERALL VEHICLE DESIGN AND PLAN/BEGIN CONSTRUCTION

- Vehicle construction demonstrations, part one
 - Chassis layout and cutting
 - Bearing cutting and deburring
 - Motor mounts
 - Solar panel mounts
- Each team member takes on lead engineer role for one vehicle system
 - Chassis (frame, axles, bearings, guidance system)
 - Transmission (motor, motor leads, motor mount, gears or pulleys, wheels)
 - Solar Collection (panel support system, panel adjustment system)
- Correct working drawing (actual size) of vehicle and bill of materials (spreadsheet)
- Weekly Design Review
 - Each team present vehicle to class
 - Class suggest questions that need answers before continuing

WEEK 5

DEMONSTRATIONS AND VEHICLE CONSTRUCTION

- Vehicle construction demonstrations, part two
 - Axle cutting and chamfering
 - Bearing mounting
 - Soldering leads to motor terminals
- Weekly Design Review
 - Each team present vehicle to class.
 - Class suggest questions that need answers before continuing
- Teacher Guidance
 - Assist students in selecting designs to build
 - Help teams split up building tasks
- Obtain materials
- Build vehicles

WEEK 6

CONSTRUCTION OF VEHICLES

- Check progress of cars
 - Find out problem areas and give design advice
 - Review race rules
- Teacher Guidance
 - Assist students to building vehicles and using tools
 - See that all team members are contributing
- Weekly Design Review
 - Each team present vehicle to class.
 - Class suggest questions that need answers before continuing
- Remind students to consider the fate of the materials they choose to use to make their vehicles
- Vehicles will be disassembled at the end of the unit and divided into recyclable, reusable and landfill items
- Student Work
 - Build Vehicle

WEEK 7

COMPLETE CONSTRUCTION OF VEHICLES AND BEGIN TESTING

- Check progress of cars
 - Check that vehicles are “legal”
 - Find out problem areas and give design advice
 - Review race rules

- Teacher Guidance
 - Assist students to building vehicles and using tools
 - See that all team members are contributing
- Weekly Design Review
 - Each team present vehicle to class.
 - Class suggest questions that need answers before continuing
- Prepare for School Race
- Student Work
 - Finish building vehicles

WEEK 8

OPTIMIZE VEHICLES

- Weekly Design Review
 - Each team present vehicle to class.
 - Class suggest questions that need answers before continuing
- Discuss performance measures from rules
- Teacher Guidance
 - Assist students in building vehicles and using tools
 - Set up test track for optimization experiments
- Student Work
 - Rework components as necessary to optimize vehicle
 - Complete vehicle
- In-class race
- Fate of the materials presentations
 - Disassembled vehicles and divide into
 - recyclable
 - reusable
 - landfill items
 - Present material determinations
- Debrief
 - What was learned
 - alternative energy
 - problem solving
 - STEAM areas
 - Improvements to activity