



DestinationZeroCarbon

CLEAN ENERGY EDUCATION PROGRAM



Hydrogen Fuel Cell Technology In the Classroom Clean Energy and STEM Learning

Presented by:



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for questions about education:
info@fablabsd.org
for questions about technology:
info@fablabstore.com





Destination Zero Carbon (DZC)

Destination Zero Carbon is a global consortium of education, clean energy technology, and participating sponsor companies that have joined forces to educate the global youth. The name implies that the global community needs to unite in the direction towards our common “destination”. The destination where we have arrived at drastically reducing and eventual elimination, of harmful carbon emissions into our Earth’s atmosphere.

DZC is a clean energy education program and international competition designed to promote environmental awareness for students through a fun and engaging platform.

Built around the excitement of competition, the program features a “design, build, and race” of 1:20 model scale future-energy drag race cars using zero emission technologies, and incorporates relevant content in Science, Math, Earth, Science, Information Technology, and Design.

This program is geared towards providing students a holistic learning experience by integrating various topics and contents in Science, Math, Geography and Design, delivered through a process of structured exercises along with highly engaged hands-on activities.

With a special focus on the Environment, DZC exposes students to the phenomenon of global warming and its negative impacts on our lives today and the future. It demonstrates to students the possibility of mitigating the situation by utilizing alternative clean energy.

The program will also introduce them to the intricacies of hydrogen fuel cell technology and its relevance as an alternative and sustainable clean fuel source to fossil fuel.

During this course, students are also introduced in general to the concept of renewable energy sources. The purpose is to show how a mixed approach of all technologies, is a necessary part to properly addressing the global effort to ensure a clean energy future. Some examples introduced during this course include:

- Solar power
- Wind power
- biofuels

LEARN:

Science, Technology, Engineering & Mathematics (STEM) form the basis of the learning outcomes associated with this program, and in addition to this, Design and related creative processes involved. Destination Zero Carbon provides a multi-disciplinary education program that introduces concepts in physics, chemistry, geography, mathematics, technology, Computer-Aided-Design and design skills that is directly applicable to the building of the students' own drag race car. This increases realism, application, and authenticity in what the students learn in the classroom.

DESIGN:

Destination Zero Carbon allows students to apply STEM concepts in the design of their own 1:20 scale drag race car. The design-centric curriculum of DZC creates greater ownership and authenticity to the student learning experience. Students will be exposed to world-leading engineering design tools like SolidWorks design software in the design of their cars.

MAKE:

Destination Zero Carbon exposes students to material handling techniques and cutting-edge fabrication technologies in realizing the students' design ideas.

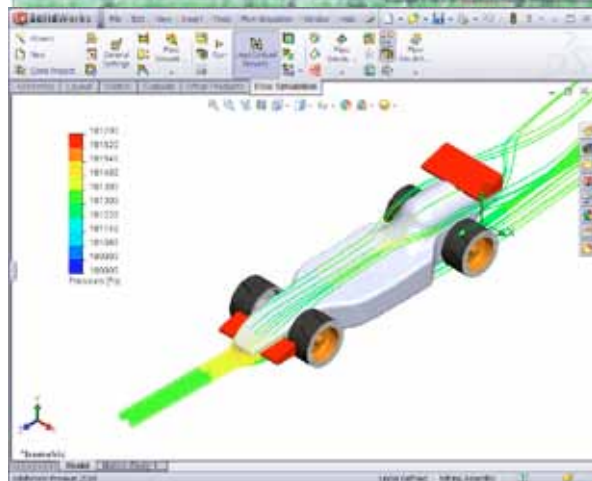
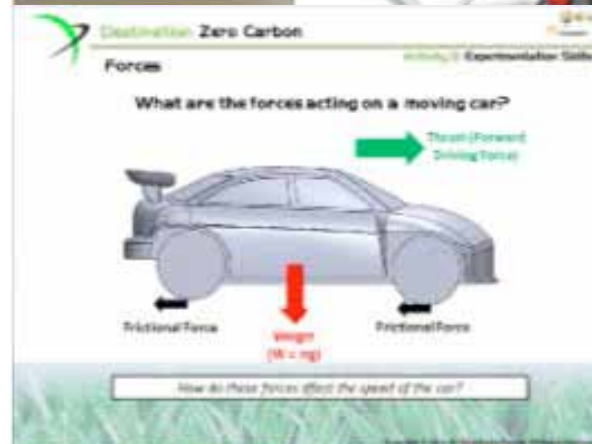
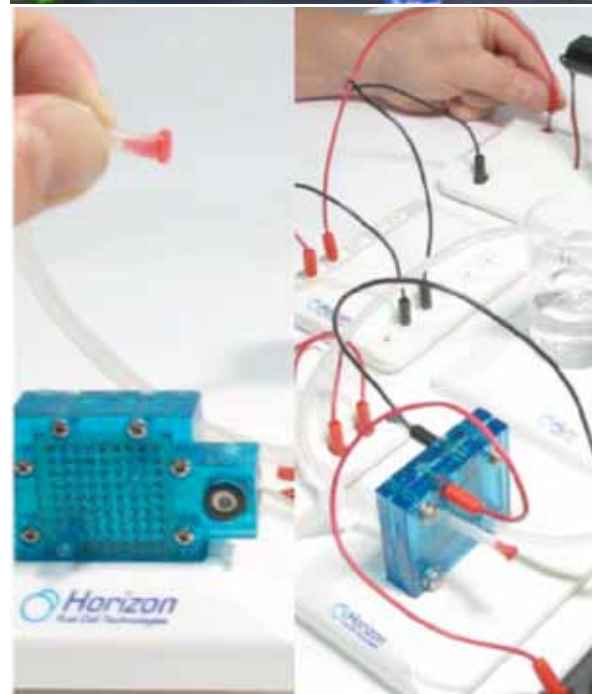
RACE:

Destination Zero Carbon provides a racing platform for students to prove how well-designed and well-built their cars are. The excitement and glamour of a drag-race, serve to engage and attract students to STEM education.

Winners from each school could possibly represent their schools in regional, national and international DZC competitions.

The images to the right represent:

- Students working with a multimeter to measure voltage across the fuel cell
- An electrolyzer (reversible fuel cell) separating hydrogen from oxygen molecules
- A simple schematic of physical forces of drag and thrust on a vehicle
- 3D rendering of a car body and its aerodynamics on Solid Works 3D modeling software.





Through this program, teachers are trained to implement new project-based learning modules into their curricula in a Train-the-Trainers session. Students are introduced to the fundamentals of electricity, chemistry and electrolysis, energy, physics, and computer-aided design.

CURRICULUM OVERVIEW

TOPIC 1 – MATHEMATICS

- Ratio & Scale
- Length, Area & Volume
- Volume, Mass & Density

TOPIC 2 – SCIENCE (EXPERIMENT SKILLS)

- Weight & Mass
- Weight vs Speed
- Friction vs Speed
- Data Collection
- Graphing Techniques

TOPIC 3 – SCIENCE (CHEMISTRY)

- Elements & Compounds
- Periodic Table
- Atoms & Molecules
- Chemical Change
- Combustion
- Electrolysis

TOPIC 4 – SCIENCE (ELECTRICITY)

- Circuits
- Electric Current
- Potential Difference & Voltage
- H₂ vs Run Time

TOPIC 5 – EARTH SCIENCE

- Greenhouse Effect
- Global Warming
- Carbon Footprint
- Lifecycle Assessment (Sustainability)
- Alternative Energy

TOPIC 6 – DESIGN WITH SOLIDWORKS

- SolidWorks 3D Computer Aided Design
- SolidWorks Sustainability
- Photorealistic Rendering

TOPIC 7 – FABRICATION & ASSEMBLY

- Fabrication with Technology (Laser Cut)
- Material Handling Skills

TOPIC 8 – RACE DAY

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Total class time is flexible (~1 week):

- Ideally 4 - 5 days, Mon-Fri for students; 1-2 days for teachers
- Implementation grade level (optimized 7- 8th Grade)
- Fully scalable in 30 student cohort size increments
- Please contact info@fablabsd.org for more information

DZC PROGRAM PACKAGE

The DZC program is a complete education package comprising of cutting-edge hardware, software and innovative education curriculum that is tied to the national curriculum.

The DZC program package includes:

- Student Activity Book
- Teachers' Guide Book
- Supporting Online Educational Materials
- SolidWorks Student Design Kit (SDK) Software
- Hydrogen Fuel Cell Lab Pack
- Drag Race Car Components
- Fabrication Materials
- Race & Experimental Track Kit

Included, in order of appearance in photos on the right:

- Course Guides and Instructor Book
- SolidWorks CAD trial Software
- Laser cutting of car body to student design specifications
- Hydrogen Fuel Cell Car, demonstration chassis
- Acrylic sheets cut to student design to form the car body
- Electrolyzer and hydrogen fuel cell car components



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Hydrogen Safety RE: Hydrogen Fuel Cells for Education

For a very comprehensive introduction to hydrogen safety, and hydrogen as a fuel, please visit the following websites sponsored by the **United States Department of Energy (DOE)** and links:

[Increase your H2I.Q.](#) | [Hydrogen & Our Energy Future](#) | [Hydrogen FAQ](#)

Although flammable under certain conditions like any fuel, hydrogen for the purposes of this class will be formed via hydrolysis in such low quantities, that risks are negligible. Hydrogen has the unique and important property where it is extremely light in air, and will rise and dissipate at a rate of 20 meters/second. This inherent property means that when in the form of a gas, and in low quantities, any released hydrogen almost immediately disperses into non-flammable ratios (<4% by volume in air). Like any fuel at higher quantities, concentrations (liquid H₂), and/or pressures there are precautions that should be taken when handling properly. Hydrogen safety for safe handling in large quantities will be discussed, but is not applicable to the lab portion of this course.

For the purpose of this course, we are creating hydrogen by way of “electrolysis” which is simply splitting water (or molecular H₂O) into its Oxygen and Hydrogen constituents using electricity, again in minute enough quantities, that do not pose any risk to the student or participants.

Furthermore, hydrogen has:

No known toxicological effects. (MSDS NR: 302-00-0025)

No known ecological damage. (MSDS NR: 302-00-0025)

Material Safety and Data Sheet (MSDS) Form #: HYDROGEN MSDS NR: 302-00-0025

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ABOUT FABLAB SAN DIEGO

Fab Lab San Diego, part of the global MIT FAB LAB NETWORK is focused on community based education, utilizing the tools and technologies related to digital fabrication to encourage and instruct youth to take ideas from concept to creation in an applied learning environment. Fab Lab Store is the commercial interface that has been appointed as the exclusive provider of this national curriculum.

ABOUT 3DCLASSWORKS

3D ClassWorks is a Singapore based company that is focused on developing and implementing SolidWorks Education Programs to supplement existing teaching methodology in schools and tertiary institutions in Singapore, and beyond. As the sole SolidWorks Authorised Reseller (Education) in Singapore we are committed in delivering high quality program catering to the relevant spectrum of the education sector.

ABOUT HORIZON

In 2003, a determined team of entrepreneurs, scientists, and engineers from around the world joined forces with a mission to introduce commercially viable, clean hydrogen fuel cell power. The company's overall vision is aligned with world, national, and scientific leaders seeking to eliminate mankind's reliance on carbon-based fuels in favor of clean, low-cost energy for all the planet's citizens, generated from climate-friendly and renewable resources.

