BIOASSAY MONITORING WATER POLLUTION, WHILE SURVEYING THE PUBLIC REGARDING OUTLOOKS ON ENVIRONMENTAL POLLUTION

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ENERGY, THE CRAZY REALITY

• ACCORDING TO THE US ENERGY INFORMATION ADMINISTRATION (EIA); IN 2016, AROUND 67% OF TOTAL ENERGY GENERATION WAS FROM FOSSIL FUELS SUCH AS: COAL, PETROLEUM, AND NATURAL GAS.

Some of the emissions from these sources include; Carbon dioxide, Carbon Monoxide, Sulfur dioxide, Particulate Matter, and heavy metals.
OKAY, SO WHAT DOES THAT MEAN?

ACCORDING TO THE EIA, THESE PRODUCTS CAN CAUSE ILLNESSES OR AILMENTS SUCH AS;

• HEART DISEASE

• RESPIRATORY DISEASES
HOW IS WATER AFFECTED?

• ACCORDING TO BENNETT (2013) THE EPA STATED THAT AROUND 55% OF OUR NATION’S WATERWAYS WERE DEEMED “POOR” AND VIRTUALLY INHABITABLE TO VARIOUS AQUATIC ORGANISMS AS WELL AS NOT CONSUMABLE BY OTHER WILDLIFE.
LETS BRING THIS HOME.....

• GENERAL ELECTRIC DUMPED 590,000 KG OF THE PCB’S INTO THE HUDSON RIVER UPSTREAM FROM NEW YORK CITY, THESE PCB’S WERE USED AS FIRE PREVENTATIVES AND INSULATORS IN ELECTRONICS (COLUMBIA UNIVERSITY PRESS, 2018).
“PCBS ARE CONSIDERED PROBABLE HUMAN CARCINOGENS AND ARE LINKED TO OTHER ADVERSE HEALTH EFFECTS SUCH AS LOW BIRTH WEIGHT, THYROID DISEASE, AND LEARNING, MEMORY DISEASES, AND IMMUNE SYSTEM DISORDERS.” (EPA)
IN THE LATE 1990S, PG&E ELECTRIC USED HEXAVALENT CHROMIUM TO FIGHT CORROSION IN THEIR COOLING TOWERS. THIS CHROMIUM ENDED UP LEAKING INTO THE WATER IN HINKLEY, CALIFORNIA (ESQUIVEL, 2015).
HOUSTON, I THINK WE HAVE A PROBLEM.

- ERIN BROCHOVICH, A LEGAL CLERK, NOTICED THAT THE CITIZENS WERE GETTING AFFECTED FROM THE BAD DRINKING WATER. SOME CITIZENS HAD CANCER, GASTROINTESTINAL ISSUES, AND INFANTS WERE BEING BORN WITH BIRTH DEFECTS DUE TO THE CHROMIUM LEVELS (BRANHUBER, 2014).
CLEAN WATER ACT

• THE CLEAN WATER ACT WAS PUT INTO PLACE IN 1948, THIS LAW SET FORTH STANDARDS FOR REGULATING POLLUTANT IN WATER. THIS WAS THE FIRST US LAW ESTABLISHED AGAINST WATER POLLUTION ACCORDING TO THE EPA (EPA, 2017).
• BIODIESEL IS AN ALTERNATIVE TO FOSSIL FUELS MADE WITH ORGANIC MATERIALS SUCH AS ETHANOL AND PLANT-BASED OILS. BIODIESEL IS THE ONLY ALTERNATIVE FUEL TO HAVE A COMPLETE EMISSIONS TEST DONE BY THE EPA UNDER THE CLEAN AIR ACT SECTION 211B (EPA, 2018), YET NO BIOASSAY TESTS HAVE BEEN DONE MONITORING BIODIESEL'S EFFECT ON INVERTEBRATES SUCH AS DAPHNIA.
BENEFITS OF ETHANOL BIODIESEL

• NO NET CARBON EMISSIONS

• ETHANOL IS BETTER FOR FUEL INJECTION EQUIPMENT
HOW TO SYNTHESIZE IT

\[
\text{Triglyceride} + 3 \text{[H}_2\text{C-OH]} \xrightarrow{\text{Catalyst}} \text{Glycerol} + 3 \text{[R-COO]} \\
\text{Methanol (3)} \quad \text{Glycerol} \quad \text{Methyl Esters (3)}
\]
• There has only been an emissions test completed for biodiesel with the EPA, never a water toxicity test....
STEF TO THE RESCUE!

- A BIOASSAY WAS DONE MONITORING THE EFFECTS OF PETROLEUM PRODUCTS AND BIODIESEL ON DAPHNIA MAGNA. 5% DILUTIONS OF 87 OCTANE, NUMBER 2 DIESEL, AND BIODIESEL WERE USED TO COMPARE THE EFFECTS ON THE DAPHNIA. WARE RIVER WATER FROM BARRE AND HARDWICK WERE USED AS WELL AS NEW YORK STATE TAP WATER TO SHOW THE DIFFERENCE IN EFFECT.
Analysis of 87 Octane *Daphnia magna* Survival

<table>
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<th>DAY NUMBER</th>
<th>87 octane</th>
<th>87 octane</th>
<th>87 octane</th>
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<td>0</td>
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<td>32</td>
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- **Ambient 1 number alive**
- **Ambient 2 number alive**
- **Tap Water number alive**
Analysis of Number 2 Diesel *Daphnia magna* Survival

![Graph showing survival of *Daphnia magna* over 7 days under different conditions.](image_url)
Analysis of Biodiesel *Daphnia magna* survival

<table>
<thead>
<tr>
<th>DAY</th>
<th>Biodiesel 0</th>
<th>Biodiesel 1</th>
<th>Biodiesel 2</th>
<th>Biodiesel 3</th>
<th>Biodiesel 4</th>
<th>Biodiesel 5</th>
<th>Biodiesel 6</th>
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<td>SURVIVAL</td>
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A ONE WAY ANOVA WAS PERFORMED TO DETERMINE IF THERE WAS A SIGNIFICANT DIFFERENCE IN THE MEANS OF BIODIESEL BEGINNING AND ENDING DAPHNIA POPULATIONS. WITH A SIGNIFICANCE (P-VALUE) OF 0.000, THE DIFFERENCE OF THE MEANS IS SIGNIFICANTLY DIFFERENT, SHOWING THAT THE CLEANER ENERGIES (CONTROL AND BIODIESEL) ARE SAFER AND PRODUCE HIGHER POPULATION NUMBERS WHEN COMPARED TO PETROLEUM PRODUCTS (87 OCTANE AND NUMBER 2 DIESEL).

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<th>Jar</th>
<th>Beginning</th>
<th>Ending</th>
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<tr>
<td>Control</td>
<td>97</td>
<td>140</td>
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<td>87 octa</td>
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<td>Number 2</td>
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<td>72</td>
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<tr>
<td>Biodiesel</td>
<td>93</td>
<td>141</td>
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A survey was also distributed before, and after a brief presentation regarding environmental pollution incidents and government aid. The surveys were distributed at Woods Memorial Library in Barre, MA, the VFW Post 1666 in Yonkers, NY and Daniels Hall on the Becker College Leicester campus. These areas were used to try and obtain various age groups.

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5. I would be willing to make slight changes in my life to conserve the environment. (Slight changes are defined as changes that minimally affect an individual’s daily life) circle one answer.

- Strongly agree
- Agree
- Strongly Disagree
- Disagree

6. When speaking about pollution, I would say the government is providing adequate support in solving environmental concerns. (Adequate support is defined as providing aid in the creation of policies to protect something such as the environment) (select one answer)

- Strongly agree
- Agree
- Strongly Disagree
- Disagree

7. When speaking about the spread of pollution, waterways (ponds and lakes) are natural reservoirs for pollution. (A reservoir is defined as a natural or man-made place that holds material such as nutrients) (Select one answer)

- Strongly agree
- Agree
- Strongly Disagree
- Disagree

8. It is likely I will recycle things such as cans, plastic or paper products. (Select one answer)

- Strongly agree
- Agree
- Strongly Disagree
- Disagree
Participants were asked to designate their highest level of education on the survey. Of the 36 participants, 1 participant designated that their highest level of education was some high school, 6 chose high school, 16 chose some college, 1 chose associates degree, 10 chose bachelor’s, and 2 chose master’s degrees.
A PAIRED SAMPLES T-TEST WAS DONE TO COMPARE PRE- AND POST SURVEY TEST RESULTS ON SURVEY KNOWLEDGE QUESTIONS. THERE WAS A SIGNIFICANT DIFFERENCE IN THE SCORES OF PRE-SURVEY KNOWLEDGE (MEAN: 11.75, STANDARD DEVIATION: ± 1.5052) AND POST-SURVEY KNOWLEDGE (MEAN: 18.3611, STANDARD DEVIATION: ± 1.2296); T (70) = -6.9 AND P= <0.0001. THE NULL HYPOTHESIS WAS REJECTED, AND THE RESEARCHER CONCLUDED THAT THERE IS A SIGNIFICANT DIFFERENCE OF PRE-SURVEY AND POST-SURVEY KNOWLEDGE SCORES, DEPICTING THAT EDUCATION DOES INFLUENCE AN INDIVIDUAL’S KNOWLEDGE OF ENVIRONMENTAL POLLUTION.
Distribution of Individual Knowledge Scores

Individuals were placed in categories based on their scores, the categories are:

- little/no
- minimal
- basic
- expert
A paired samples t-test was conducted to compare pre-and post-behavioral survey scores in participants. There was a significant difference in the scores of pre-survey behavior (mean: 3.2778, standard deviation: ± 0.5866) and post-survey behavior (mean: 4.75, standard deviation: ± 0.722); t (70) = -3.27 and p = <0.001670. The null hypothesis was rejected, and the researcher concluded that there is a significant difference of pre-survey and post-survey behavior scores, depicting that education does influence an individual’s thoughts on environmentally conservative behaviors.
Individuals were placed in categories based on their behavior scores on the pre- and post-surveys, the maximum amount of points for the behavior questions was a 9. The category breakdowns were as follows:

- 0-4: not environmentally conservative
- 5-7: moderately conservative (good)
- 8+: environmentally conservative (great)
WHAT DOES THIS MEAN?

• EDUCATION CAN CHANGE THE FUTURE, ESPECIALLY REGARDING ENVIRONMENTAL ISSUES.

• BIODIESEL IS A SAFER ALTERNATIVE TO FOSSIL FUELS BOTH FOR HUMANS AND WILDLIFE
FUTURE RESEARCH

• DUE TO TIME CONSTRAINTS, ONLY 36 PARTICIPANTS WERE SURVEYED, IN THE FUTURE THERE SHOULD BE AT LEAST 100 PARTICIPANTS.

• WIDE SET DEMOGRAPHIC

• DUE TO FINANCIAL CONSTRAINTS, ONLY ONE SET OF DAPHNIA WERE SAMPLED (4 JARS/WATER SOURCE). IN THE FUTURE THIS SHOULD BE REPEATED AT LEAST 3 TIMES.

• LARGER PETROLEUM AND BIODIESEL DILUTIONS.
CITATIONS


• "CHRONIC TOXICITY - FRESHWATER WET METHODS." EPA, ENVIRONMENTAL PROTECTION AGENCY, 19 APR. 2018, WWW.EPA.GOV/CWA-METHODS/CHRONIC-TOXICITY-FRESHWATER-WET-METHODS.

• THE COLUMBIA UNIVERSITY PRESS. "HUDSON (RIVER, UNITED STATES)." THE COLUMBIA ENCYCLOPEDIA, 6TH ED, ENCYCLOPEDIA.COM, 2018, WWW.ENCYCLOPEDIA.COM/PLACES/UNITED-STATES-AND-CANADA/US-PHYSICAL-GEOGRAPHY/HUDSON-RIVER.


• FOX, JOSH, DIRECTOR. GASLAND. ATYPIK FILMS, 2011.


