

NMSEF ENTRY FORM

Please place all forms in numerical order with this form as the top sheet for each student project.

Student Name: Mary Smith Grade: 11
 Teacher/Sponsor: Tom Jones School Year: 2019-2020
 Student School: Ephrata High School School District: Ephrata Area SD
 Project Title: Various Techniques to Maximize Biofuel Output in Algae

Junior Division Category

- Consumer Science
- Earth Science
- Engineering
- Life Science
- Physical Science
- Plant Science

Senior Division Category

- Animal Science
- Behavioral and Social Sciences
- Biochemistry, Cellular and Molecular Biology
- Biomedical, Health, Translational Medical Sciences
- Chemistry
- Computational Biology, Bioinformatics, and Biomedical Engineering
- Earth and Environmental Sciences
- Energy: Chemical
- Energy: Physical
- Environmental and Mechanical Engineering
- Materials Sciences
- Mathematics
- Microbiology
- Physics and Astronomy
- Plant Sciences
- Robotics, Systems Software, and Embedded System

Please select only ONE category

NMSEF SRC Approval Form

Required for ALL/MOST Projects

- Signed Checklist for Adult Sponsor (1)
- Student Checklist (1A)
- A Research Plan
- 5 Sources in Bibliography
- Signed Approval Form (1B)
- Risk Assessment Form (3)

(indicates a problem form – see comments for details)

ANY Project with the following forms MUST be reviewed by a Governing SRC member

- Signed Qualified Scientist Form (2)
- Human Subjects Form (4)
- Vertebrate Animal Form (5A)
- Vertebrate Animal Form (5B)
- Potentially Hazardous Biological Agents Form (6A)
- Human and Vertebrate Animal Tissue Form (6B)
- Continuation Projects Form (7)

(indicates a problem form – see comments for details)

Project Proposal **APPROVED**

- Research may begin immediately; no further conditions are required by the SRC.

Project Proposal **CONDITIONALLY APPROVED**

- Research may begin immediately; the above conditions must be rectified in the final application. Make corrections and re-submit between November and January for final SRC approval.

Project Proposal **DENIED**

- See above for details of denial, please make contact with fair officials for assistance on how to rectify any issues.

- Regulated Research Institution Project (Form 1C)
- Continuation Project (Form 7)
- Human Consent Project (Form 4)

Comments: _____

 SRC Member Signature

 Governing SRC Member Signature (if required)

 00/00/00
 SRC Review Date

Checklist for Adult Sponsor (1)

This completed form is required for ALL projects.

To be completed by the Adult Sponsor in collaboration with the student researcher(s):

Student's Name(s): Mary Smith

Project Title: Various Techniques to Maximize Biofuel Output on Algae

1. I have reviewed the ISEF Rules and Guidelines.
2. I have reviewed the student's completed Student Checklist (1A) and Research Plan/Project Summary.
3. I have worked with the student and we have discussed the possible risks involved in the project.
4. The project involves one or more of the following and requires prior approval by an SRC, IRB, IACUC or IBC:
 - Humans Potentially Hazardous Biological Agents
 - Vertebrate Animals Microorganisms rDNA Tissues
5. Items to be completed for **ALL PROJECTS**
 - Adult Sponsor Checklist (1) Research Plan/Project Summary
 - Student Checklist (1A) Approval Form (1B)
 - Regulated Research Institutional/Industrial Setting Form (1C) (when applicable; after completed experiment)
 - Continuation/Research Progression Form (7) (when applicable)

Additional forms required if the project includes the use of one or more of the following (check all that apply):

- Humans**, including student designed inventions/prototypes. (Requires prior approval by an Institutional Review Board (IRB); see full text of the rules.)
 - Human Participants Form (4) or appropriate Institutional IRB documentation
 - Sample of Informed Consent Form (when applicable and/or required by the IRB)
 - Qualified Scientist Form (2) (when applicable and/or required by the IRB)
- Vertebrate Animals** (Requires prior approval, see full text of the rules.)
 - Vertebrate Animal Form (5A) - for projects conducted in a school/home/field research site (SRC prior approval required.)
 - Vertebrate Animal Form (5B) - for projects conducted at a Regulated Research Institution. (Institutional Animal Care and Use Committee (IACUC) approval required prior experimentation.)
 - Qualified Scientist Form (2) (Required for all vertebrate animal projects at a regulated research site or when applicable)
- Potentially Hazardous Biological Agents** (Requires prior approval by SRC, IACUC or IBC, see full text of the rules.)
 - Potentially Hazardous Biological Agents Risk Assessment Form (6A)
 - Human and Vertebrate Animal Tissue Form (6B) - to be completed in addition to Form 6A when project involves the use of fresh or frozen tissue, primary cell cultures, blood, blood products and body fluids.
 - Qualified Scientist Form (2) (when applicable)
 - The following are exempt from prior review but require a Risk Assessment Form 3: projects involving protists, archae and similar microorganisms, for projects using manure for composting, fuel production or other non-culturing experiments, projects using color change coliform water test kits, microbial fuel cells, and projects involving decomposing vertebrate organisms.
- Hazardous Chemicals, Activities and Devices** (No SRC prior approval required, see full text of the rules.)
 - Risk Assessment Form (3)
 - Qualified Scientist Form (2) (required for projects involving DEA-controlled substances or when applicable)
- Other**
 - Risk Assessment Form (3)

Tom Jones
Adult Sponsor's Printed Name

Tom Jones
Signature

08/26/19
Date of Review (mm/dd/yy)

717-867-5309
Phone

tom_jones@yahoo.com
Email

Student Checklist (1A)

This form is required for ALL projects.

1. a. Student/Team Leader: Mary Smith Grade: 11
Email: mary_smith@yahoo.com Phone: 717-867-5309
b. Team Member: N/A c. Team Member: N/A

2. Title of Project:
Various Techniques to Maximize Biofuel Output on Algae

3. School: Ephrata High School School Phone: 717-721-1478
School Address: 803 Oak Blvd., Ephrata, PA 17522

4. Adult Sponsor: Tom Jones Phone/Email: 717-867-8809

5. Does this project need SRC/IRB/IACUC or other pre-approval? Yes No Tentative start date: 12/1/19

6. Is this a continuation/progression from a previous year? Yes No
If Yes:

a. Attach the previous year's Abstract and Research Plan/Project Summary

b. Explain how this project is new and different from previous years on

Continuation/Research Progression Form (7)

7. This year's laboratory experiment/data collection:

Actual Start Date: (mm/dd/yy)

End Date: (mm/dd/yy)

8. Where will you conduct your experimentation? (check all that apply)

Research Institution School Field Home Other: _____

9. List name and address of all non-home and non-school work site(s):

Name: _____

Address: _____

Phone/
email _____

10. Complete a Research Plan/Project Summary following the Research Plan/Project Summary instructions and attach to this form.

11. An abstract is required for all projects after experimentation.

Mary Smith

Ephrata High School

Title: Various Techniques to Maximize Biofuel Output on Algae

Category: Environmental Engineering

- A. Which technique for extracting oil from algae works the best?
- B. It is hypothesized that biodiesel derived from microalgal biomass will be the most efficient compared to methane produced by anaerobic digestion, and photo biologically produced biohydrogens.

C. Procedure

Biodiesel from micro algal biomass

1. Algae is grounded with a mortar and pestle as finely as possible.
2. The ground is dried for 20 minutes at 80°C in an incubator.
3. Hexane and ether solution (both 20 ml) are mixed with the dried ground algae.
4. This mixture is set for 24 hours.
5. The mixture is filtered and weighted.
6. The oil that was left is evaporated to release hexane and ether solution using a rotary evaporator.
7. 0.25g of NaOH is mixed with 24 ml of methanol and stirred for 20 minutes.
8. The catalyst (NaOH), methanol, and algae oil were all put in a conical flask.
9. The conical flask is shaken for 3 hours at 300rpm.
10. After the shaking it is let to set for 16 hours.
11. The layers of sedimentation and biodiesel are separated carefully by a flask separator.
12. The Biodiesel is cleaned by 5% water.
13. Biodiesel is dried and kept under a running fan for 12 hours.
14. The biodiesel is stored, weighted, and the pH is measured.

Anaerobic respiration to produce methane

15. A liquid suspension of fine solid particles is made from the algae.
16. The suspension is run through a fluidized bed that contains granules which transform the particals into sugar. It contains acidific bacteria capable of transforming sugars into volatile fatty acids.

17. The suspension goes through a process of decantation, to remove solid particles and extract a decanted liquid.

18. The decanted liquid goes along a bed that contains methanogenic bacteria which causes

the liquid to release a gas mixture.

Photobiologically produced biohydrogens

19. Algae is cultured and grown photo synthetically.

20. Sulfur deprivation is imposed in the growth medium. This alters their metabolism.

21. The cultures are sealed and become anaerobic.

22. Hydrogen gas is then produced in light but not the dark.

23. An inverted burette is used to measure the amount of H₂ gas.

Data will be analyzed by comparing the amount of methane hydrogen and biodiesel that is extracted from the algae. Then from this proportions will be used to see which one will have the highest energy output.

D. Bibliography

- 1) Sharif Hossain, A.B.M., A. Salleh, A.N. Boyce, P. chowdhury and M. Naquiuddin, 2008. Biodiesel Fuel Production from Algae as Renewable Energy. Am. J. Biochem. Biotechnol., 4: 250- 254.
- 2)Bamberger ES, King O, Erbes DL, Gibbs M (1982) H₂ and CO₂ evolution by anaerobically adapted *Chlamydomonas reinhardtii* F60. Plant Physiol69:1268-1273
- 3) Angelidaki I, Ellegaard L, Ahring BK. Applications of the anaerobic digestion process. In: Ahring BK, editor. Biomethanation. Berlin: Springer; 2003. p. 1-33
- 4) Chen, P.H. Factors influencing methane fermentation of micro-algae. PhD thesis, University of California, Berkeley, CA, USA, 1987
- 5)Chen Y, Cheng JJ, Creamer KS. Inhibition of anaerobic digestion process: a review. Bioresource Technology 2008;99:4044-6

Approval Form (1B)

A completed form is required for each student, including all team members.

1. To Be Completed by Student and Parent

a. Student Acknowledgment:

- I understand the risks and possible dangers to me of the proposed research plan.
- I have read the ISEF Rules and Guidelines and will adhere to all International Rules when conducting this research.
- I have read and will abide by the following Ethics statement

Student researchers are expected to maintain the highest standards of honesty and integrity. Scientific fraud and misconduct are not condoned at any level of research or competition. Such practices include but are not limited to plagiarism, forgery, use or presentation of other researcher's work as one's own, and fabrication of data. Fraudulent projects will fail to qualify for competition in affiliated fairs and ISEF.

Mary Smith

Mary Smith

8/30/19

Student's Printed Name

Signature

Date Acknowledged (mm/dd/yy)
(Must be prior to experimentation.)

- ### b. Parent/Guardian Approval: I have read and understand the risks and possible dangers involved in the Research Plan/Project Summary. I consent to my child participating in this research.

John Smith

John Smith

9/1/19

Parent/Guardian's Printed Name

Signature

Date Acknowledged (mm/dd/yy)
(Must be prior to experimentation.)

2. To be completed by the local or affiliated Fair SRC

(Required for projects requiring prior SRC/IRB APPROVAL. Sign 2a or 2b as appropriate.)

- ### a. Required for projects that need prior SRC/IRB approval BEFORE experimentation (humans, vertebrates or potentially hazardous biological agents).

The SRC/IRB has carefully studied this project's **Research Plan/Project Summary** and all the required forms are included. My signature indicates approval of the **Research Plan/Project Summary** before the student begins experimentation.

Douglas Weaver

SRC/IRB Chair's Printed Name

D. Weaver

Signature

9/4/19
Date of Approval (mm/dd/yy)
(Must be prior to experimentation.)

OR

- ### b. Required for research conducted at all Regulated Research Institutions with no prior fair SRC/IRB approval.

This project was conducted at a regulated research institution (not home or high school, etc.), was reviewed and approved by the proper institutional board before experimentation and complies with the ISEF Rules. **Attach (1C) and any required institutional approvals (e.g. IACUC, IRB).**

SRC Chair's Printed Name

Signature

Date of Signature (mm/dd/yy)
(May be after experimentation)

3. Final ISEF Affiliated Fair SRC Approval (Required for ALL Projects)

SRC Approval After Experimentation and Before Competition at Regional/State/National Fair

I certify that this project adheres to the approved **Research Plan/Project Summary** and complies with all ISEF Rules.

Regional SRC Chair's Printed Name

Signature

Date of Approval (mm/dd/yy)

State/National SRC Chair's Printed Name
(where applicable)

Signature

Date of Approval (mm/dd/yy)

Qualified Scientist Form (2)

May be required for research involving human participants, vertebrate animals, potentially hazardous biological agents, and hazardous substances and devices. Must be completed and signed before the start of student experimentation.

Student's Name(s) Mary Smith

Title of Project Various Techniques to Maximize the Biofuel Output on Algae

To be completed by the Qualified Scientist:

Scientist Name: Dr. Jim Greene

Educational Background: Microbiology

Degree(s): MS, PhD

Experience/Training as relates to the student's area of research: Director of Virology Lab at Milton Medical School

Lab Director

Milton Medical School

Position:

Institution:

500 University Drive, Milton, DE

jim_greene@miltonedu.com

Address:

Email/Phone:

1. Have you reviewed the ISEF rules relevant to this project? Yes No
2. Will any of the following be used?
 - a. Human participants Yes No
 - b. Vertebrate animals Yes No
 - c. Potentially hazardous biological agents (microorganisms, rDNA and tissues, including blood and blood products) Yes No
 - d. Hazardous substances and devices Yes No
3. Will this study be a sub-set of a larger study? Yes No
4. Will you directly supervise the student? Yes No
 - a. If no, who will directly supervise and serve as the Designated Supervisor? Tom Jones
 - b. Experience/Training of the Designated Supervisor:
BS Biology, 5 years lab experience.

To be completed by the Qualified Scientist:

I certify that I have reviewed and approved the Research Plan/Project Summary prior to the start of the experimentation. If the student or Designated Supervisor is not trained in the necessary procedures, I will ensure her/his training. I will provide advice and supervision during the research. I have a working knowledge of the techniques to be used by the student in the Research Plan/Project Summary. I understand that a Designated Supervisor is required when the student is not conducting experimentation under my direct supervision.

Jim Greene

Qualified Scientist's Printed Name

J. Greene

Signature

09/01/19

Date of Approval (mm/dd/yy)

To be completed by the Designated Supervisor when the Qualified Scientist cannot directly supervise.

I certify that I have reviewed the Research Plan/Project Summary and have been trained in the techniques to be used by this student, and I will provide direct supervision.

Tom Jones

Designated Supervisor's Printed Name

Tom Jones

Signature

09/03/19

Date of Approval (mm/dd/yy)

717-867-5309

Phone

tom_jones@yahoo.com

Email

Risk Assessment Form (3)

Must be completed before experimentation.

Student's Name(s) Mary Smith

Title of Project Various Techniques to Maximize Biofuel Output on Algae

To be completed by the Student Researcher(s) in collaboration with Designated Supervisor/Qualified Scientist:
(All questions must be answered; additional page(s) may be attached.)

1. List all hazardous chemicals, activities, or devices that will be used; identify microorganisms exempt from pre-approval (see Potentially Hazardous Biological Agent rules).

Hexane and ether solution, rotary evaporator, biodiesel, methane, bacteria that is transforming sugar

2. Identify and assess the risks involved in this project.

Hexane and ether could be swallowed. Evaporator could break, biodiesel could be spilled or consumed

3. Describe the safety precautions and procedures that will be used to reduce the risks.

Hexane and ether will be used in with proper lab protection, with adult supervision and in a fume hood

4. Describe the disposal procedures that will be used (when applicable).

All solutions will be disposed on in separate labeled containers. This will be picked up by chemical waste service

5. List the source(s) of safety information.

Attached Safety Data Sheets for Hexane, Sodium Hydroxide and Methanol.

To be completed and signed by the Designated Supervisor (or Qualified Scientist, when applicable):

I agree with the risk assessment and safety precautions and procedures described above. I certify that I have reviewed the Research Plan/Project Summary and will provide direct supervision.

Tom Jones
Designated Supervisor's Printed Name

Tom Jones
Signature

9/1/19
Date of Review (mm/dd/yy)

EHS Science Teacher
Position & Institution

717-867-5309
Phone or email contact information

BS Biology; 5 years lab experience
Experience/Training as relates to the student's area of research

Potentially Hazardous Biological Agents Risk Assessment Form (6A)

Required for research involving microorganisms, rDNA, fresh/frozen tissue (including primary cell lines, human and other primate established cell lines and tissue cultures), blood, blood products and body fluids.
SRC/IACUC/IBC approval required before experimentation.

Student's Name(s) Mary Smith

Title of Project Various Techniques to Maximize the Biofuel Output on Algae

To be completed by the **QUALIFIED SCIENTIST/DESIGNATED SUPERVISOR** in collaboration with the student researcher(s). All questions are applicable and must be answered; additional page(s) may be attached.

SECTION 1: PROJECT ASSESSMENT

1. Identify potentially hazardous biological agents to be used in this experiment. Include the source, quantity and the biosafety level risk group of each microorganism.
Methanosarcina mazei, Lactobacillus buchneri, BSL-1, acquired from ATCC.
2. Describe the site of experimentation including the level of biological containment.
Experiment will be completed in classroom with restricted access and traffic flow.
3. Describe the procedures that will be used to minimize risk (personal protective equipment, hood type, etc.).
Gloves, safety glasses will be used during work. Adult supervision at all times.
4. What final biosafety level do you recommend for this project given the risk assessment you conducted?
BSL-1
5. Describe the method of disposal of all cultured materials and other potentially hazardous biological agents.
All materials and bacteria will be autoclaved prior to disposal in normal trash.

SECTION 2: TRAINING

1. What training will the student receive for this project?
Student will receive aseptic technique training as well as autoclave training.
2. Experience/training of Designated Supervisor as it relates to the student's area of research (if applicable).
BS Biology, 5 years lab experience

SECTION 3: For ALL CELL LINES, MICROORGANISMS AND TISSUES - To be completed by the QUALIFIED SCIENTIST or DESIGNATED SUPERVISOR - Check the appropriate box(es) below:

- Experimentation on the microorganisms/cell lines/tissues to be used in this study will NOT be conducted at a Regulated Research Institution, but will be conducted at a (check one) BSL-1 or BSL-2 laboratory. This study has been reviewed by the local SRC and the procedures have been approved prior to experimentation.
- Experimentation on the microorganisms/cell lines/tissues to be used in this study will be conducted at a Regulated Research Institution and was approved by the appropriate institutional board prior to experimentation; institutional approval forms are attached.
Origin of cell lines: _____ Date of IACUC/IBC approval _____
- Experimentation on the microorganisms/cell lines/tissues to be used in this study will be conducted at a Regulated Research Institution, which does not require pre-approval for this type of study. The SRC has reviewed that the student received appropriate training and the project complies with ISEF rules.

CERTIFICATION - To be SIGNED by the QUALIFIED SCIENTIST or DESIGNATED SUPERVISOR

The QS/DS has seen this project's research plan and supporting documentation and acknowledges the accuracy of the information provided above. This study has been approved as a (check one) BSL-1/ BSL-2 study, and will be conducted in an appropriate laboratory.

Tom Jones

Qs/DS Printed Name

Signature

9/11/19
Date of review (mm/dd/yy)

SECTION 4: CERTIFICATION - To be completed by the LOCAL or AFFILIATED FAIR SRC

The SRC has seen this project's research plan and supporting documentation and acknowledges the accuracy of the information provided above.

SRC Printed Name

Signature

Date of review (mm/dd/yy)

Safety Data Sheet

according to 29CFR1910/1200 and GHS Rev. 3

Effective date : 12.14.2014

Page 1 of 7

Hexane (n-Hexane)

SECTION 1 : Identification of the substance/mixture and of the supplier

Product name : Hexane (n-Hexane)

Manufacturer/Supplier Trade name:

Manufacturer/Supplier Article number: S25352A

Recommended uses of the product and uses restrictions on use:

Manufacturer Details:

AquaPhoenix Scientific
9 Barnhart Drive, Hanover, PA 17331

Supplier Details:

Fisher Science Education
15 Jet View Drive, Rochester, NY 14624

Emergency telephone number:

Fisher Science Education Emergency Telephone No.: 800-535-5053

SECTION 2 : Hazards identification

Classification of the substance or mixture:



Environmentally Damaging

Chronic hazards to the aquatic environment, category 2



Flammable

Flammable liquids, category 2



Health hazard

Aspiration hazard, category 1

Reproductive toxicity, category 2



Irritant

Skin irritation, category 2

Specific target organ toxicity following single exposure, category 3

STOT SE 3

Aspiration Tox.1

Flammable Liq. 2

Aquatic Chronic 2

Reproductive 2

Skin Irritation, Category 2

STOT RE 2

Signal word :Danger

Hazard statements:

Explosive; mass explosion hazard

Explosive; severe projection hazard

Heating may cause an explosion

Safety Data Sheet

according to 29CFR1910/1200 and GHS Rev. 3

Effective date : 12.14.2014

Page 1 of 7

Sodium Hydroxide, 0.5M

SECTION 1 : Identification of the substance/mixture and of the supplier

Product name : Sodium Hydroxide, 0.5M

Manufacturer/Supplier Trade name:

Manufacturer/Supplier Article number: S25881

Recommended uses of the product and uses restrictions on use:

Manufacturer Details:

AquaPhoenix Scientific
9 Barnhart Drive, Hanover, PA 17331

Supplier Details:

Fisher Science Education
15 Jet View Drive, Rochester, NY 14624

Emergency telephone number:

Fisher Science Education Emergency Telephone No.: 800-535-5053

SECTION 2 : Hazards identification

Classification of the substance or mixture:



Corrosive

Serious eye damage, category 1
Corrosive to metals, category 1
Skin corrosion, category 1B

Skin Corr. 1B
Eye corr. 1
Metal Corr. 1

Signal word : Danger

Hazard statements:

May be corrosive to metals
Causes severe skin burns and eye damage
Causes serious eye damage

Precautionary statements:

If medical advice is needed, have product container or label at hand

Keep out of reach of children

Read label before use

Keep only in original container

Do not breathe dust/fume/gas/mist/vapours/spray

Wash ... thoroughly after handling

Wear protective gloves/protective clothing/eye protection/face protection

Absorb spillage to prevent material damage

IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing

IF SWALLOWED: Rinse mouth. Do NOT induce vomiting

Wash contaminated clothing before reuse

Safety Data Sheet
according to 29CFR1910/1200 and GHS Rev. 3

Effective date : 01.08.2015

Page 1 of 8

Methanol, Lab Grade, 4L

SECTION 1 : Identification of the substance/mixture and of the supplier

Product name : Methanol, Lab Grade, 4L

Manufacturer/Supplier Trade name:

Manufacturer/Supplier Article number: S25426A

Recommended uses of the product and uses restrictions on use:

Manufacturer Details:

AquaPhoenix Scientific
9 Barnhart Drive, Hanover, PA 17331

Supplier Details:

Fisher Science Education
15 Jet View Drive, Rochester, NY 14624

Emergency telephone number:

Fisher Science Education Emergency Telephone No.: 800-535-5053

SECTION 2 : Hazards identification

Classification of the substance or mixture:



Flammable

Flammable liquids, category 2



Toxic

Acute toxicity (oral, dermal, inhalation), category 3



Health hazard

Specific target organ toxicity following single exposure, category 1

AcTox Dermal. 3

Flammable liq. 2

AcTox Oral. 3

AcTox Inhaln. 3

Stot SE. 1

Signal word : Danger

Hazard statements:

Highly flammable liquid and vapour

Toxic if swallowed

Toxic in contact with skin

Toxic if inhaled

Causes damage to organs

Precautionary statements:

If medical advice is needed, have product container or label at hand

Keep out of reach of children

Read label before use