Driving Question – How can reclaimed or degraded land be utilized to produce biomass for a green energy source?

Teacher Timeline

Week 1					
	Mon	Tues	Wed	Thurs	Fri
Activities Project Map	20 Question Pre-Test Mud pie Activity Crossword (Scaffolding Homework – Due Tuesday) Reflection (3 Things)	Soil Crossword Due Break into specialist groups Slice 1 → Porosity Study Slice 2 → N-P-K Study Slice 3 → Germination Study Slice 4 → Soil Column Study Slices 5-8 Reserved for additional studies Reflection (3 Things)	Porosity Study → drainage issues Plant water retention Groundwater issues NPK Study → determine soil deficiencies and plant nutrition requirements Germination Study →Corn, Grass, Sorghum seeds Soil Column Study → Soil Texture Triangle Reflection (3 Things)	Specialists meet with each "pie" group and share results of tests from "slices". Collaboration among "pie" groups will ensue to determine issues concerning soil and plant nutrition requirements "Pie" groups will then determine need for additional testing. Reflection (3 Things)	Run tests if needed. Determine relatedness among soil characteristics Prepare presentation to report to peers about "Mud pie" Group Quiz/Reflection
Facilitation	Present driving question to students How many have heard of biofuel? What they know about soil? What does soil have to do with biofuel? Present mud pie task	Split "pie" groups into soil specialist groups. Go to each specialty group to make sure they know what they are testing, aware of materials to use for testing, see if there are questions about topic or procedure.	Go to each group and discuss the questions left on the wall from yesterday. Ask about their results and why these results are important.	Move from group to group and ask members for feedback about results to make sure all members understand the outcomes of all tests. Confirm which tests students would like to run or rerun with remaining slices of "pie".	Monitor soil tests. Check with students to monitor progress on projects. Make sure all group members have something to share and feel included.
Debriefing	How they chose their mud pie recipe? What do you think we will do with these mud pies? Students complete mini-reflection (tell me 3 things)	Each group will put any questions they have about their specialty on their question wall. Students complete mini-reflection (tell me 3 things)	Each specialty group will share a 2-3 minute brief on the "research" part of their study. Students complete mini-reflection (tell me 3 things)	"Circle Time" (students sit in a circle in the room and shared questions and concerns are listed on the board and talk as a class together to come up with suggestions and solutions)	Group reflection and share thoughts with the rest of the class. Review expectations for Monday's presentations.
Assessment	Formative based upon class discussion and individual reflections	Formative assessment based upon individual reflection. Soil Crossword	Summative assessment on the mini-debriefing from specialty groups. Formative assessment based upon individual reflection.	Formative assessment based upon individual reflection.	Summative assessment based upon the group quiz/reflection that contains 5 core questions that all groups should be able to answer.

Driving Question – How can reclaimed or degraded land be utilized to produce biomass for a green energy source?

Student Timeline

Week 1					
	Mon	Tues	Wed	Thurs	Fri
Activities Project Map	20 Question Pre-Test Mud pie Activity Crossword – Due Tuesday Reflection (3 Things)	Soil Crossword Due Break into specialist groups Slice 1 → Porosity Study Slice 2 → N-P-K Study Slice 3 → Germination Study Slice 4 → Soil Column Study Slices 5-8 Reserved for additional studies Reflection (3 Things)	Porosity Study → drainage issues Plant water retention Groundwater issues NPK Study → determine soil deficiencies and plant nutrition requirements Germination Study →Corn, Grass, Sorghum seeds Soil Column Study → Soil Texture Triangle Reflection (3 Things)	Specialists meet with each "pie" group and share results of tests from "slices". Collaboration among "pie" groups will ensue to determine issues concerning soil and plant nutrition requirements "Pie" groups will then determine need for additional testing. Reflection (3 Things)	Run tests if needed. Determine relatedness among soil characteristics Prepare presentation to report to peers about "Mud pie" – Due Monday Group Quiz/Reflection
NOTES SHEET **Add in comments, questions and personal reflections**					

Driving Question – How can reclaimed or degraded land be utilized to produce biomass for a green energy source?

Student Timeline

Week 2					
	Mon	Tues	Wed	Thurs	Fri
Activities Project Map	Mud pie Analysis KWL Chart Community survey (farmer, utility worker) on green energy sources – Due Next Tuesday	Soil Box Activity Boxes will consist of Reclaimed soil from mine Local soil from farm Remediated soil from a contaminated industrial site. Capped sanitary landfill Begin soil tests on boxes Reflection (3 question reflection)	3 types of seed will be started (corn, grass, sorghum) Finish soil tests on boxes Collect data Predict what will grow in which box and why Class discussion Reflection (3 question reflection) Set up lab for next day. Crossword on Biofuels – Due Friday	Fermentation chamber activity Collect Data Students conduct research on fermentation while monitoring reactions in the bottle Reflection (3 question reflection)	Biofuels Crossword due Unit Reflection and Feedback Debriefing Discussion of Misconceptions KWL Chart Completion Go over final project that will be due next Friday. Group reflection – 5 questions for guest speaker.
NOTES SHEET Add in comments, questions and personal reflections					

Driving Question – How can reclaimed or degraded land be utilized to produce biomass for a green energy source?

Teacher Timeline

Week 2					
	Mon	Tues	Wed	Thurs	Fri
Activities Project Map	Mud pie Analysis KWL Chart Community survey (farmer, utility worker) on green energy sources	Present Boxes to class and 1 specialist from each area will be in each group. One box will be given to each group. Boxes will consist of Reclaimed soil from mine Local soil from farm Remediated soil from a contaminated industrial site. Capped sanitary landfill Begin soil tests on boxes Reflection (3 question reflection)	3 types of seed will be started (corn, grass, sorghum) Finish soil tests on boxes Collect data Predict what will grow in which box and why Class discussion Reflection (3 question reflection) Set up lab for next day. Crossword on Biofuels – Due Friday	Fermentation chamber activity Collect Data Bottles and Balloons will be needed Students conduct research on fermentation while monitoring reactions in the bottle Reflection (3 question reflection)	Biofuels Crossword due Unit Reflection and Feedback Debriefing Discussion of Misconceptions KWL Chart Completion Go over final project that will be due next Friday. Group Quiz & 2 Questions for the Guest speaker
Facilitation	Determine group presentation order. Make sure groups have proper technology needed for presentations. Help along presentations by asking guiding questions.	Present soil boxes and environment scenarios to the class. Divide students into new groups (see activity description) Generate student discussion around what soil properties these samples have based on their expertise.	Make sure students get seeds in the soils samples at the beginning of class. Act as scribe to write down class predictions about plant growth as a whole group. Ask students about crop choices, how they are used and how it can lead to biofuel Introduce the fermentation activity to students	Go from to group to group asking questions about the procedure and predictions. Monitor student progress Make sure students are completing the research component of the assignment by questioning each group about fermentation and its uses in biofuel and industry.	Facilitate student questions and comments about yesterday's debriefing exercise. Readdress the driving question and recap where we are at this time in answering. Reassess KWL chart from Monday and add in new information learned and new questions asked.
Debriefing	Give students feedback on presentations to help them prepare for the cumulative presentation next week. Fill out KWL chart as a class to summarize learning to this point on the driving question.	Use the wall board to write down what things you need to do tomorrow as soon as the class begins. Also write down questions you have about the topic.	Use probing questions can think of areas Indiana that are similar to the various boxes.	Have students share their results with the class. Discuss any discrepancies in data. Talk about what are the applications of fermentation. (In fermentation which product do you think is desired for green energy?)	See where students feel we should go now. Write down on the class board what things do we still need to know to answer the driving question, future goals, adjust timeline & any follow up.
Assessment	Rubrics will be used to grade the presentation and provide student feedback. There will be individual and group feedback.	Formative assessment using individual reflections.	Formative assessment using individual reflections.	Formative assessment using individual reflections.	Remind students about survey that is due on Tuesday. Summative assessment using group reflections. Biofuel Crossword

Driving Question – How can reclaimed or degraded land be utilized to produce biomass for a green energy source?

Student Timeline

Week 3					
	Mon	Tues	Wed	Thurs	Fri
Activities Project Map	Guest Speaker/ Video Conference FAME test (Possible) Two question Reflection	Surveys due go over class results Internet research to prep for presentation on Friday Perform additional investigations on biomass to biofuels Two question reflection	Internet research to prep for presentation on Friday Perform additional investigations on biomass to biofuels Two question reflection	Measurements of plants Collection of data Prep for presentation Two question reflection	Final product presentation to peers and/or community members Homework – 1 page individual reflection of what they learned, what they enjoyed, and most challenging of the project.
NOTES SHEET Add in comments, questions and personal reflections					

Driving Question – How can reclaimed or degraded land be utilized to produce biomass for a green energy source?

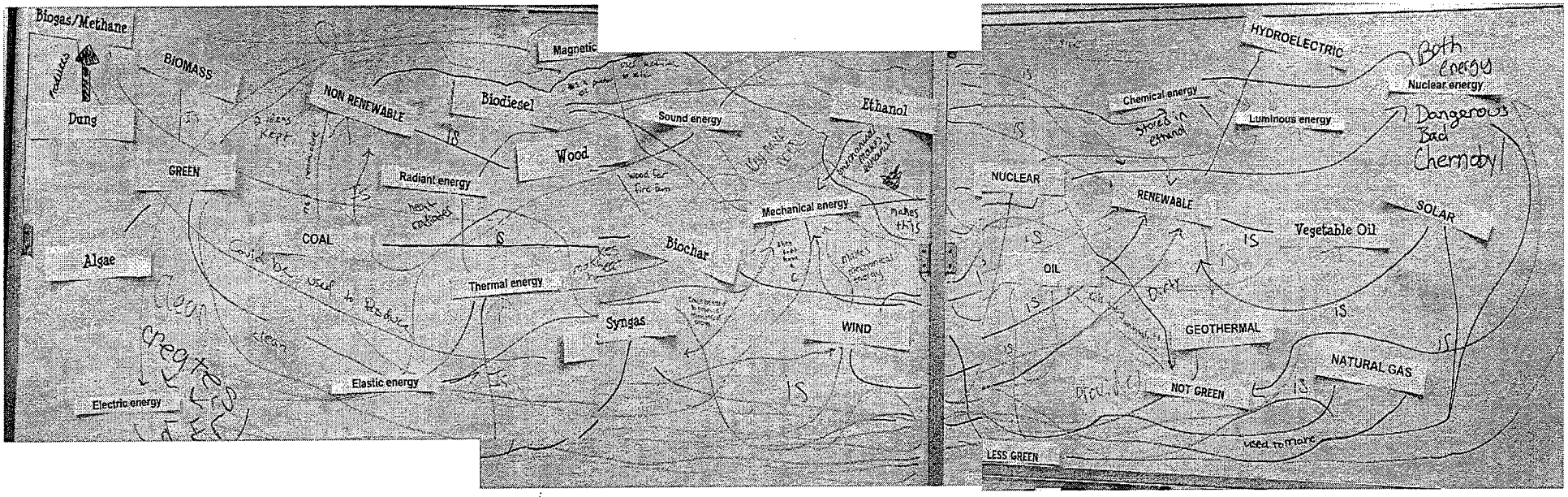
Teacher Timeline

Week 3					
	Mon	Tues	Wed	Thurs	Fri
Activities Project Map	Guest Speaker/ Video Conference: Nate Mosier or Lab Assistant to present FAME test Two question Reflection	Surveys due go over class results Internet research to prep for presentation on Friday Perform additional investigations on biomass to biofuels Two question reflection	Internet research to prep for presentation on Friday Perform additional investigations on biomass to biofuels Two question reflection	Measurements of plants Collection of data Prep for presentation Two question reflection	Final product presentation to peers and/or community members Homework – 1 page individual reflection of what they learned, what they enjoyed, and most challenging of the project.
Facilitation	Introduce guest speaker. Have a list of questions to ask in addition to their "on the spot".	Have students share what they found out about biomass with the class. Circulate room Keep groups on task, answer questions, check progress	Circulate room Keep groups on task, answer questions, check progress	Facilitate the measurement and recordings of plant growth from soil boxes. Discuss what students have learned concerning soil and biomass produced Ask about connections to biofuel production	Make sure that transition between presentations runs smoothly. Have technology supplies ready for groups. Ask questions to determine the preparedness of groups
Debriefing	Have students summarize what they learned during the presentation. If time allows see what questions students have about upcoming project.	Students reflect – what have you done, what do you need to do.	Students reflect – what have you done, what do you need to do.	Make sure all students are clear about presentations for tomorrow.	Have students share initial thoughts about how the presentations went. Assign individual reflection.
Assessment	Thank you note for homework and mention one specific thing they liked hearing about.	Project Checklist	Outline of presentation due Project Checklist	Formative assessment with the individual reflections	Summative assessment in the form of rubrics for their final product as well as for their group participation.

Week 4 – Monday – Final Debriefing

Students discuss their one page reflection. Collect reflections. Post-test.

Project reflection – What changes should be done with the project in the future? What things were hard or difficult to understand? Which things should definitely be included in the future? Words of advice to give to other classes?


Biogas/Methane
BIOMASS
Dung
GREEN
Algae
NON RENEWABLE
COAL
Magnetic
Biodiesel
Wood
Sound energy
Ethanol
Radiant energy
Mechanical energy
Biochar
Thermal energy
Syngas
WIND
Elastic energy
Electric energy
HYDROELECTRIC
Both energy
Nuclear energy
Dangerous
Bad
Chernobyl
Chemical energy
Luminous energy
NUCLEAR
RENEWABLE
SOLAR
Vegetable Oil
OIL
GEOTHERMAL
NATURAL GAS
NOT GREEN
LESS GREEN

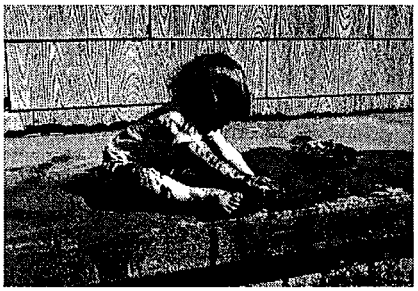
http://library.thinkquest.org/20331/intro/ NAME_____

1. What are fossil fuels?
2. What do the provide?
3. When will they run out?
4. What is the goal of this web page?
5. Describe the history of energy during these time periods:
    a. Prehistoric
    b. 1600's – 1800's
    c. 1900's and Modern times
    d. What happened during the 1970's Mideast Oil Crisis?
6. Under Physics what shocking statement is made?
7. What is the most important law of physics?
8. What is our actual problem?
9. What is the primary form of energy used by people all over the world?
10. What is biomass?
11. Check out each section under physics of energy and summarize it here:
    a. Kinetic and potential energy explained
    b. Missing mass and the theory of relativity
    c. All about vapor pressure
    d. The physics definition of energy
12. Under Types, list the types of energy sources here and examples in each category
    a. EXAMPLES
    b. EXAMPLES
    c. EXAMPLES

13. For each of the energy sources listed on the left side of the page please fill out this chart:

ENERGY SOURCE	THEORY	EXAMPLES	ADVANTAGES	DISADVANTAGES

Driving Question: How can reclaimed or degraded land be utilized to produce biomass for a green energy source?



Mud Pies!

Over the next three weeks you will be investigating and developing your own answer to the question printed at the top of this page. Making mud pies is just the beginning of your adventure into ***Problem Based Learning***. There will be days you will find exciting and interesting and there will be days you will be frustrated. It's ok. It's all part of the plan and you will be fine as you develop and exercise your problem-solving and critical thinking skills.

Today your group is to develop your own MUD PIE recipe. You will find the "ingredients" and other materials to make your pie in the supply area of the room. When you are done making and observing your pie you will need to CUT it into 8 equal pieces and place it in the designated "drying" area until tomorrow. Be sure to CLEAN UP YOUR LAB AREAS!

Materials:

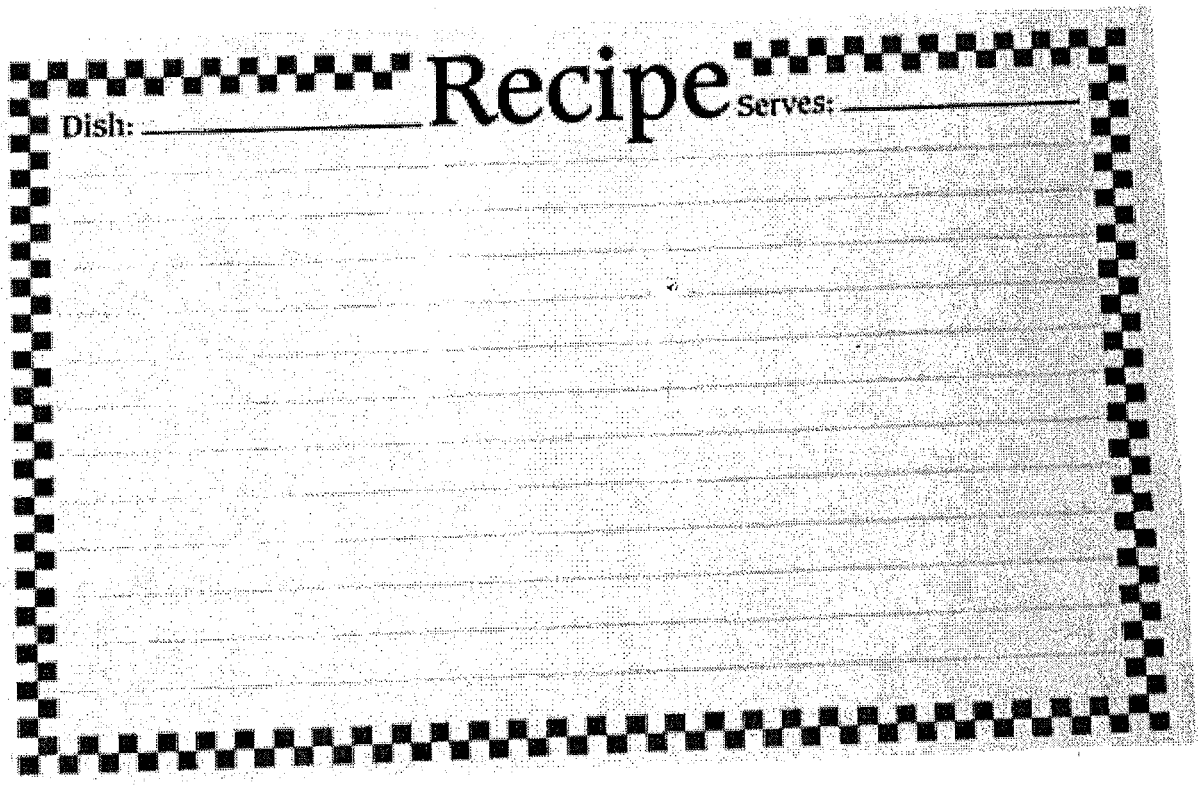
8" or 9" aluminum pie pans
Sand, silt, clay, and potting soil
Water
Graduated cylinders
Soil scoops (spoons or trowels)
Buckets
Plastic spoons and knives
Plastic cups
Rulers
Balances or Scales

Optional: Heat Lamps or heaters to help with "baking" the pies overnight

On the next page please describe your pie. In addition to recording your group's recipe, be sure to include on the recipe card WHAT you did to make your pie (step by step). Then answer these questions:

HOW and WHY you chose the ingredients
WHAT the pie looks like including diagram with measurements
HOW you think it is going to help you answer the question: ***How can reclaimed or degraded land be utilized to produce biomass for a green energy source?***

Record your group's MUD PIE recipe here:



HOW did your group select the ingredients and WHY?

WHAT does your pie looks like? (Include diagram with measurements)

HOW you think it is going to help you answer the question: ***How can reclaimed or degraded land be utilized to produce biomass for a green energy source?***

Driving Question: How can reclaimed or degraded land be utilized to produce biomass for a green energy source?

Soil Specialist Activity

Today your pie group will divide your pie into 8 pieces. You will need to use just 4 of the pieces today. ***SAVE the other 4 pieces for future tests and observations!*** You will see there are several testing stations around the room. You will find directions for the tests at each station. Each person in the group will become a soil specialist and perform one kind of test on one of the slices of the pie. Each specialist of the group will be responsible for reporting back to the original pie group the results of their special soil test. One person will become a POROSITY specialist, one will become a NUTRIENT specialist, one will become a SEED GERMINATION specialist and one will become a SOIL TEXTURE specialist. It is critical that each person take their role seriously so that quality information can be gathered and used to answer the driving question.

Materials will be found at each testing station

Porosity testing: funnel, cheesecloth/ filter paper, timer, graduated cylinder, water, beaker/ cup

Soil Nutrient testing: Soil testing kits for Nitrogen, Phosphorus, and Potassium and pH.

Germination study: 3 small (3oz) cups per group, water, rulers, corn seeds, grass seeds, and sorghum seeds.

Soil Column/Texture materials: jar or graduated cylinder, water, ruler, soil triangle

IN YOUR NOTEBOOK be sure to describe the test(s) you performed, your observations, and your results.

Then answer these questions:

WHAT do your individual results mean?

Based on your pie group's results, DESCRIBE the overall soil qualities of your mud pie.

HOW you think this information is going to help you answer the question:

How can reclaimed or degraded land be utilized to produce biomass for a green energy source?

Thursday – Mud Pie and Soil Testing Analysis

Group Questions – Prepare a short PowerPoint or Prezi about your soil.

You should include how it was made, and what you discovered or observed in your soil.

Also, your presentation should address these important questions:

1. Why do you think each of the mud pie tests was conducted?
    a. Porosity
    b. N-P-K
    c. Germination
        i. Monocots
        ii. Dicots
    d. Soil column/Soil Texture

2. What are some of the important issues to think about when considering a biofuel crop?

3. What are some of the important issues to think about when considering the use of reclaimed or degraded land?

4. What biofuel crop do you think would grow in YOUR soil? Why?

EMAIL YOUR PRESENTATION TO MRS. DANIELS AT
kathy_daniels@olemiss.k12.in.us
PRESENTATIONS WILL BE GIVEN ON MONDAY!!!

SOIL PUZZLES WILL BE DUE ON MONDAY TOO!

Mud Pie and Soil Testing Analysis Presentation

1. Shows/describes how "Mud Pie" was made, and what you discovered or observed in your soil. 2 4 6 8 10
2. Porosity 2 4 6 8 10
3. N-P-K 2 4 6 8 10
4. Germination (Monocots/Dicots) 2 4 6 8 10
5. Soil column/Soil Texture 2 4 6 8 10

6. What are some of the important issues to think about when considering a biofuel crop? 2 4 6 8 10
7. What are some of the important issues to think about when considering the use of reclaimed or degraded land? 2 4 6 8 10
8. What biofuel crop do you think would grow in YOUR soil? Why?

   2 4 6 8 10
9. Project was completed on time 0 5 10
10. Project presentation in front of class was of high quality, understandable, and presented with enthusiasm. 0 5 10

Dirt! The Movie Name_____

Who are these people? The people shown in this movie have special experience and expertise with dirt. What do some of these people have to SAY about dirt? Please record quotes from 5 of these people appearing in the movie.

Wangari Maathai
Vandana Shiva
Pierre Rabhi
Benjamin Shute and Miriam Latzer
Danny Percich
Jeremy Narby
William Bryant Logan
Peter Girguis
Paul Stamets
John Todd
David Orr
Miguel Altieri
Juan Vicente Sanchez
Jerry Glover
Will Brinton
Kevin Rowell and Marisha Farnsworth
Richard Register
Barbara Damrosch
Majora Carter
Andy Lipkis
Janine Benyus
Wes Jackson
James Jiler
John Cannizzo
Gary Vaynerchuk
Jeanette Armstrong
Alice Waters
Hilda Krus
Katrina Dawkins, Lottie Manuel, & Pablo Rolon
Juan Mighty, Hugh Cherrington, & Sharon Jackson

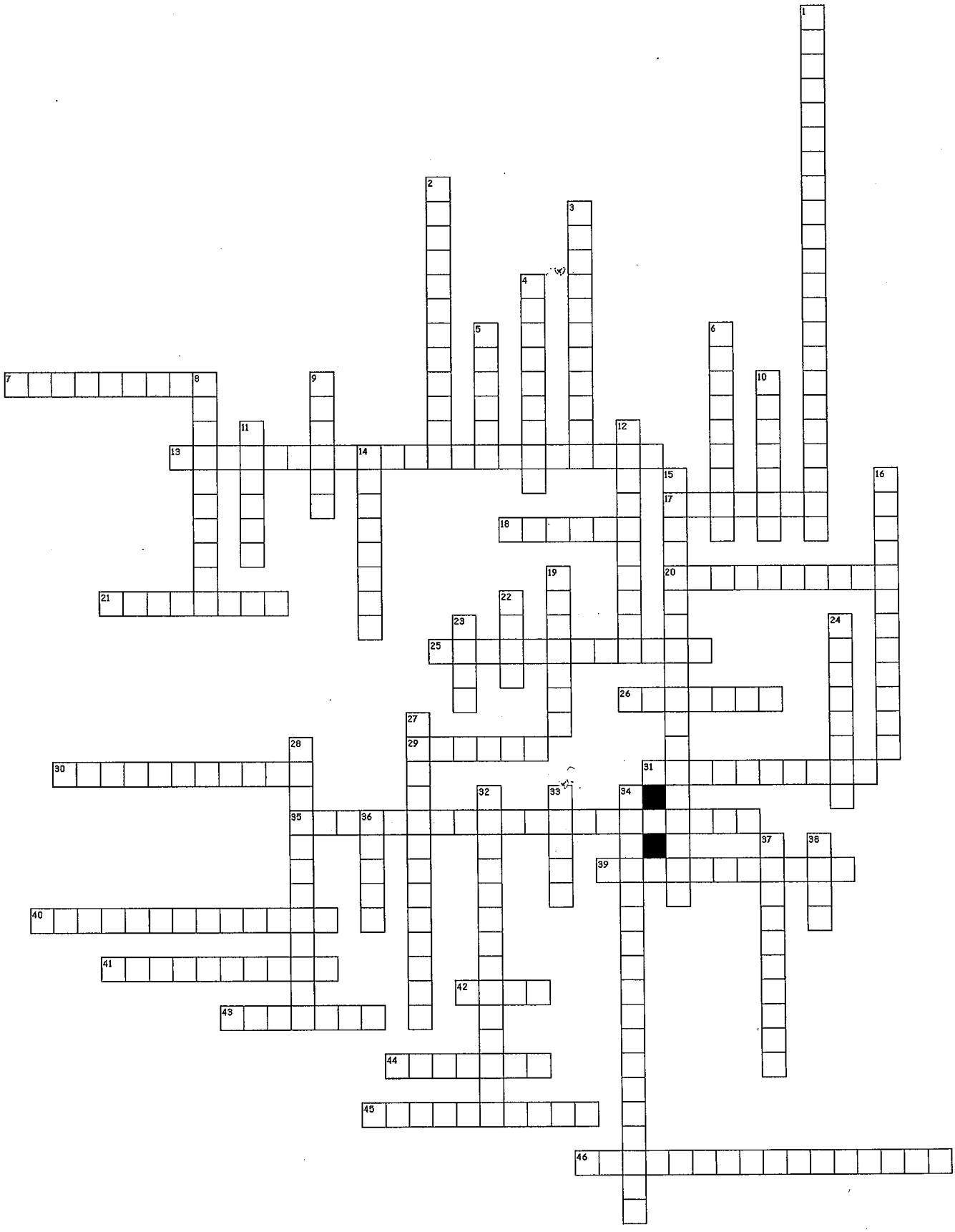
What is dirt? The movie talks about dirt in a lot of ways...list some of the names given to dirt in the movie:

6.
7.
8.
9.
10.
11.
12.
13.
14.
15.

Nature's All-Purpose Material – The movie shows many of the uses of dirt. List some of the ways dirt is used in the movie:

16.
17.
18.
19.
20.
21.
22.
23.
24.
25.

Soil Terms



Across

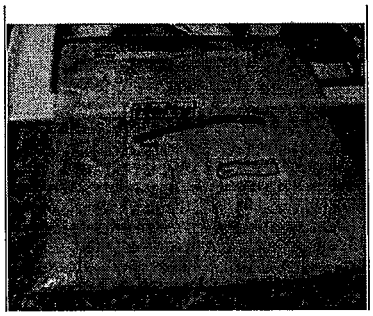
7. also called a drainage basin
13. these resources can NOT be replaced or take millions of years to replace once used, like fossil fuels
17. the movement or removal of soil by wind, water, ice, or gravity
18. get most of their nutrients from soil and use the soil as support and anchoring
20. area in ground water that sits on top of the zone of saturation, it is the water line
21. precipitation that contains acids due to air pollution
25. diagram showing the relative quantities of sand, silt, and clay in soil
26. a layer of soil in a profile or where the sun rises and sets
29. water that does not soak into the ground, instead it ends up in streams, creeks, or other surface water feature.
30. a vertical picture of all the layers of soil
31. using waste from the home and yard to make new soil
35. the breakdown of rock into smaller pieces by physical means
39. this means water can NOT pass through soil
40. a low area of land where water runs into
41. flat land on the side of the river that has rich sediments
42. a loose mixture of small mineral fragments and organic material and gives plants a place to grow, provides nutrition for plants, and takes years to form; created from the gradual breaking down of solid rocks
43. the act of making a new product from an existing one
44. the soil on top of the profile where you'd find humus and living organisms
45. is when rocks are broken down by wind, water, and plant roots
46. the various methods by which humans take care of the soil

Down

1. the process by which softer, less weather-resistant rocks wear away, leaving harder, more weather-resistant rocks behind
2. where spaces are filled with air in the top zone
3. water that soaks into the ground and collects in pores
4. using resources to the point where they can't be replaced
5. a high area of land separating 2 basins
6. a chemical reaction in which an element combines with oxygen to form an oxide
8. organisms that break down dead organisms and put them back into the soil
9. topsoil, subsoil, bedrock are the ___of the soil
10. this soil layer is formed from bedrock over a long period of time with the help of water
11. the largest soil size
12. the laying down of soil as wind or water speed slows down
14. the grinding and wearing down of rock surface by other rock or sand particles
15. resources that can be replaced or replenished like trees, water, or sunlight
16. careful use of resources to avoid wasting them
19. bottom soil layer made up of large pieces of rock
22. type of soil that is fine and powder like
23. type of soil that is a mixture of clay, sand, and humus, and is good for growing plants because it doesn't hold too much water and has many nutrients
24. the process by which rainwater dissolves and carries away the materials and nutrients in topsoil
27. the material in soil that has been left by living organisms as waste or decaying remains
28. the ability of water to pass through soil
32. where spaces are completely filled with water
33. the act of using a product again
34. the chemical breakdown of rocks and minerals into new substances
36. type of soil that is made up of rotted or decayed plants and dead animals or remains
37. rock that is the source of soil
38. the smallest soil size that tightly packs and holds a lot of water

1. abrasion the grinding and wearing down of rock surface by other rock or sand particles
2. acidrain precipitation that contains acids due to air pollution
3. aerationzone where spaces are filled with air in the top zone
4. Bedrock bottom soil layer made up of large pieces of rock
5. chemicalweathering the chemical breakdown of rocks and minerals into new substances
6. clay the smallest soil size that tightly packs and holds a lot of water
7. composting using waste from the home and yard to make new soil
8. Conservation careful use of resources to avoid wasting them
9. decomposer organisms that break down dead organisms and put them back into the soil
10. Depletion using resources to the point where they can't be replaced
11. deposition the laying down of soil as wind or water speed slows down
12. differentialweathering the process by which softer, less weather-resistant rocks wear away, leaving harder, more weather-resistant rocks behind
13. divide a high area of land separating 2 basins
14. drainagebasin a low area of land where water runs into
15. erosion the movement or removal of soil by wind, water, ice, or gravity
16. Floodplain flat land on the side of the river that has rich sediments
17. gravel the largest soil size
18. groundwater water that soaks into the ground and collects in pores
19. horizon a layer of soil in a profile or where the sun rises and sets
20. humus type of soil that is made up of rotted or decayed plants and dead animals or remains
21. impermeable this means water can NOT pass through soil
22. Layers topsoil, subsoil, bedrock are the ___of the soil
23. leaching the process by which rainwater dissolves and carries away the materials and nutrients in topsoil
24. loam type of soil that is a mixture of clay, sand, and humus, and is good for growing plants because it doesn't hold too much water and has many nutrients
25. mechanicalweathering the breakdown of rock into smaller pieces by physical means
26. Nonrenewableresources these resources can NOT be replaced or take millions of years to replace once used, like fossil fuels
27. organicmatter the material in soil that has been left by living organisms as waste or decaying remains
28. oxidation a chemical reaction in which an element combines with oxygen to form an oxide
29. parentrock rock that is the source of soil
30. permeability the ability of water to pass through soil
31. plants get most of their nutrients from soil and use the soil as support and anchoring
32. recycle the act of making a new product from an existing one
33. Renewableresources resources that can be replaced or replenished like trees, water, or sunlight
34. reuse the act of using a product again
35. runoff water that does not soak into the ground, instead it ends up in streams, creeks, or other surface water feature.
36. saturationzone where spaces are completely filled with water
37. silt type of soil that is fine and powder like
38. soil a loose mixture of small mineral fragments and organic material and gives plants a place to grow, provides nutrition for plants, and takes years to form; created from the gradual breaking down of solid rocks
39. soilconservation the various methods by which humans take care of the soil
40. soilprofile a vertical picture of all the layers of soil
41. soiltriangle diagram showing the relative quantities of sand, silt, and clay in soil
42. Subsoil this soil layer is formed from bedrock over a long period of time with the help of water
43. Topsoil the soil on top of the profile where you'd find humus and living organisms
44. watershed also called a drainage basin
45. watertable area in ground water that sits on top of the zone of saturation, it is the water line
46. Weathering is when rocks are broken down by wind, water, and plant roots

Driving Question: How can reclaimed or degraded land be utilized to produce biomass for a green energy source?



Fermentation in a BAG Activity

http://www.exploratorium.edu/cooking/bread/activity-yeast.html
http://www.glbrc.org/sites/default/files/fermentation_challenge.pdf
http://www.glbrc.org/education/educationalmaterials#returntotop

Today your group will investigate the breakdown of plant materials by yeast, also known as fermentation. Your goal is to determine what kinds of plant products are best for use in biofuel production using ***fermentation***.

Materials

- *Sandwich size ziplock baggies*
- *Electronic balances*
- *Permanent Markers*
- *Yeast – MAXIMUM 2 GR PER BAG*
- *Biomass materials to test: sugar, flour, corn syrup, corn starch, vegetable oil, chopped grass, pine chips)*
- *Scissors / Mortar and pestle*
- *Warm water*
- *Thermometers*
- *Graduated cylinders (for warm water)*
- *Rulers*
- *Timer*

As a group decide how to use the available materials to test the fermentation rate of yeast. You will need to collect both QUALITATIVE and QUANTITATIVE data. You will need to determine what proportions of yeast, water, and plant biomass to use to get optimal results. You will also need to discuss with your group what data, observations, and information you need to record during this experiment. Your group must create a data table to organize and record data for analysis. The lab should be set up and everything but the water loaded into the bottles the day before the lab is to be performed. Tomorrow, you will add the warm water (whatever quantity you decide), and use much of the period for data collection and analysis.

IN YOUR NOTEBOOK be sure to describe the test(s) you performed, your observations, and your results. You should include a labeled diagram or picture of your experimental set up.

Then answer these questions in your notebook:

1. What is yeast?

2. What is the equation for fermentation?

3. How is fermentation different from cellular respiration?

4. What are commercial uses of fermentation?

5. What plant product did you expect to react the most? WHY? Least? WHY?

6. WHAT did you find out by doing this lab?

7. Based on your group's results, DESCRIBE the overall best plant product tested in this lab for fermentation and why you believe this to be so.

8. Would this material be good for biofuel production?

   Why or why not?

9. Research 3 types of biofuels to find out where each comes from, how prevalent they are, and what is the future of each fuel like?

10. HOW you think this information is going to help you answer the question: ***How can reclaimed or degraded land be utilized to produce biomass for a green energy source?***

Bag Cont.	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	Total after 24 hrs

Biofuel Debate Info

Your group is a biofuel company interested in growing and using _____ as a renewable energy resource.

A wealthy environmentally-conscious benefactor has given the town of Gas City a very large amount of land to be given to the company with the best rationale and plan for the growth, processing, and distribution of their biofuel product. The company chosen by the benefactor will receive start up funds and a yearly operational budget for the first 5 years of the biofuel plant's operation, but this budget must be presented to the benefactor at the town meeting in order to receive these funds. The budget amount may be any amount as long as the company can account for how it is going to be responsibly spent.

The land is located on both sides of the Mississinewa River. One half of the land is on the side of the river that has been used for many years as a source of sand and gravel, but is no longer used. Many large empty or water-filled gravel pits remain. The other half of the land is located along the opposite side of the river and is layered with clay and sediments from the river that frequently floods. The land on this side of the river has been used for over 50 years as a junk yard. The cars and trash have been cleared away, but the soil may contain toxins and other unwanted materials.

All 6 companies will meet on Monday to present their business plans to the benefactor and town council. Tuesday will be for questions and any debate between companies that will demonstrate why their company should be chosen to receive the land and start up funds.

Each group and each individual will receive a test grade for their work and participation in this activity.

http://c3bio.org/resources/26/supportingdocs
http://extension.purdue.edu/renewable-energy/indiana-biomass-working-group.shtml
http://advancedbiofuelsusa.info/

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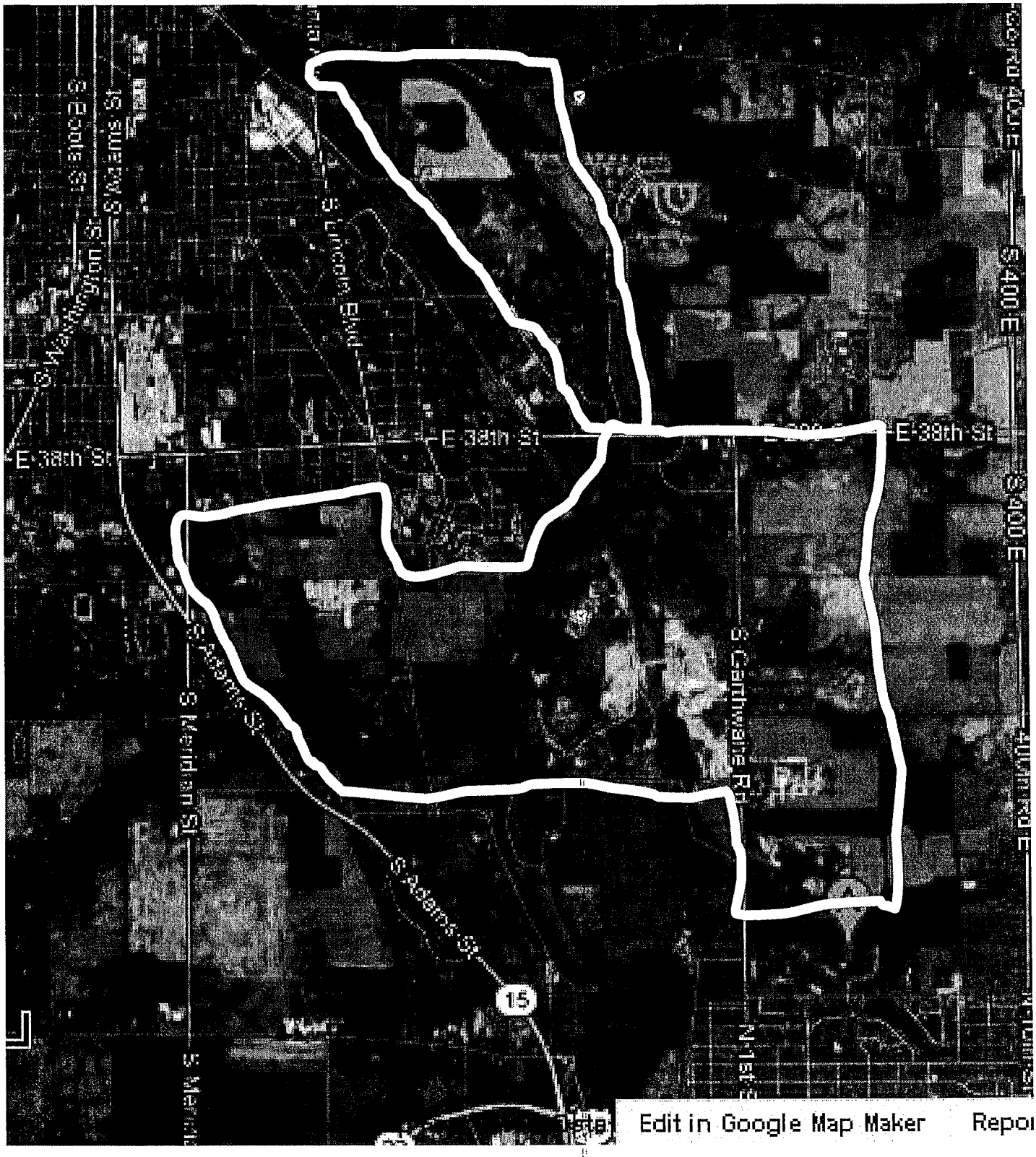


Approximately 4 Square miles WEST of the river and 12 miles EAST of the river. More land can be used/purchased if your company can justify the need to the benefactor. Remember to keep in mind the different soil and environmental conditions on each side of the river. Also don't forget to address issues dealing with land use, crop choice, biofuel production, distribution, and sales. You may have to consider legal and political issues as well.

Biofuel Debate Rubric (DAY 1)

Primary Fuel Type

Corn	soybeans	hemp	milletia trees	rapeseed	grass
Corn	soybeans	hemp	sunflowers	algae	grass

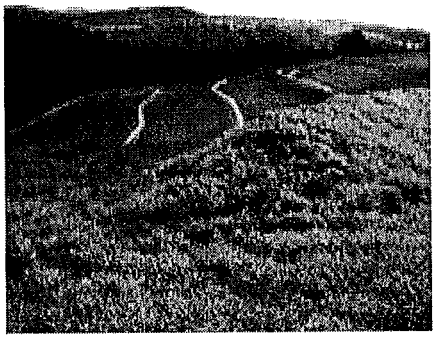
Company Members _____

_____

Rationale for Biofuel/Company Need	Crop Choice	Soil Condition Considerations
Processing Details	Distribution Plan	Environmental Issues (air, soil, water)
Sales Plan	Social Issues	Legal/Policy Issues
Budget Plan (start up and operational)	Secondary land uses	Employment Issues
Other.....		

Time _____ Group Grade _____

Driving Question: How can reclaimed or degraded land be utilized to produce biomass for a green energy source?



Environment in a Box Activity

Today your group will investigate soil from a specific environment. Your goal is to determine what kinds of plants, desirable for biofuel production, could be grown in each environmental site. The four environments represented by the boxes are reclaimed mine, capped sanitary landfill, remediated industrial site, and local farm field.

Materials

Plastic shoe boxes filled with representative soils
Soil testing materials from week 1
Seeds, same varieties as week 1
Plastic cup or other watering device
Rulers
Tape
Balance

As a group decide how to use the available materials to investigate the properties of your environmental box. You will need to collect both QUALITATIVE and QUANTITATIVE data. You will need to determine soil quality, appropriateness for various biofuel energy crops, and feasibility of using the environment your group was given for biomass production to produce biofuel. You will also need to discuss with your group what data, observations, and information you need to record during this investigation. Your group must create a data table to organize and record data for analysis. AFTER your group has finished soil testing the box should be divided into 1/3's with tape so that test plots of each type of seed can be planted and grown over the next week or so.

IN YOUR NOTEBOOK be sure to describe the test(s) you performed, your observations, and your results. You should include a labeled diagram or picture of your experimental set up.

Then answer these questions in your notebook:

1. Describe the unique challenges associated with each of the environmental boxes in this lab. Why might we consider these areas for biofuel crops?

2. Thoroughly compare and contrast the four environmental sites. Be sure to consider soil characteristics, laws or other restrictions on the land, plant requirements, etc.

3. What are other uses of these types of environments?

4. What plants do you predict will do well in each environment? And WHY?

5. What plants do you predict will do poorly in each environment? And WHY?

6. WHAT did you find out by doing this lab?

7. Based on your group's results and research, DESCRIBE the overall best plant and environment combination for biomass to be grown for biofuel production. Also discuss why you believe this to be so.

8. Would this plant material be good for biofuel production?

   Why or why not?

9. Why do you think these 4 environments were chosen for this lab? List specific examples in your response to this question.

10. HOW you think this information is going to help you answer the question: ***How can reclaimed or degraded land be utilized to produce biomass for a green energy source?***

Guiding Questions for Week 1

1. What were the results of your porosity test? Why do you think that might have been the case?
2. What nutrients were in your soil? Is that good/bad? Why?
3. What did the soil column tell you about the materials in your mud pie?
4. If you had to classify your soil using the soil triangle, which type of soil would you use?
5. Did any of the plants germinate in your soil? Which one(s)? Why do you think those plants did/did not germinate?
6. Is there anything else you can do to test your soil to learn more about its quality?

Group Quiz/Reflection Name: _____Score:_____10

Answer the following questions completely and thoroughly, using complete sentences, appropriate grammar, punctuation, and choose vocabulary from the unit you are investigating.

1. List the three major macronutrients found in the soil and explain why they are important to plants.

2. How is soil texture important to the water holding capacity of soil?

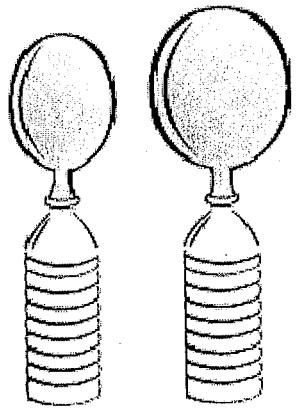
3. Utilizing the Soil Triangle calculate the following classification of soil:
   43% Sand, 33% Silt, 24% Clay _____

   Why would this soil be a good soil for plants? Utilize the vocabulary words relating to the functions of soils and plants.

4. Explain why large soil pores are better for plants than small pores.

5. Explain why erosion or removal of topsoil is detrimental to the productivity of the land

Driving Question: How can reclaimed or degraded land be utilized to produce biomass for a green energy source?



Fermentation in a Bottle Activity

http://www.exploratorium.edu/cooking/bread/activity-yeast.html
http://www.glbrc.org/sites/default/files/fermentation_challenge.pdf
http://www.glbrc.org/education/educationalmaterials#returntotop

Today your group will investigate the breakdown of plant materials by yeast, also known as fermentation. Your goal is to determine what kinds of plant products are best for use in biofuel production.

Materials

*20 oz pop bottles (**not** water bottles)*
Latex balloons
String
Tape
Rulers
Yeast
Warm water
Thermometers
Biomass materials to test: sugar, corn meal, sorghum molasses, corn syrup, vegetable oil, chopped grass
Mortar and pestle
Electronic balances
Graduated cylinders
Timer

As a group decide how to use the available materials to test the fermentation rate of yeast. You will need to collect both QUALITATIVE and QUANTITATIVE data. You will need to determine what proportions of yeast, water, and plant biomass to use to get optimal results. You will also need to discuss with your group what data, observations, and information you need to record during this experiment. Your group must create a data table to organize and record data for analysis. The lab should be set up and everything but the water loaded into the bottles the day before the lab is to be performed. Tomorrow, you will add the warm water (whatever

quantity you decide), and use much of the period for data collection and analysis.
IN YOUR NOTEBOOK be sure to describe the test(s) you performed, your observations, and your results. You should include a labeled diagram or picture of your experimental set up.

Then answer these questions in your notebook:

1. What is yeast?

2. What is the equation for fermentation?

3. How is fermentation different from cellular respiration?

4. What are commercial uses of fermentation?

5. What plant product did you expect to react the most? WHY? Least? WHY?

6. WHAT did you find out by doing this lab?

7. Based on your group's results, DESCRIBE the overall best plant product tested in this lab for fermentation and why you believe this to be so.

8. Would this material be good for biofuel production?

   Why or why not?

9. Research 3 types of biofuels to find out where each comes from, how prevalent they are, and what is the future of each fuel like?

10. HOW you think this information is going to help you answer the question: ***How can reclaimed or degraded land be utilized to produce biomass for a green energy source?***

PRESENTATION RUBRIC

(for secondary and upper elementary grades)

	Below Standard	Approaching Standard	At Standard	Above Standard
Eye Contact & Physical Presence	▸ does not look at audience; reads notes or slides ▸ holds things in hands nervously or keeps hands in pockets ▸ posture does not show confidence; (fidgets, slouches) ▸ clothes are not appropriate for the occasion	▸ makes some eye contact, or scans the room quickly, but reads notes or slides most of the time ▸ uses a few gestures but they do not look natural, or keeps hands too still to look natural ▸ posture shows some confidence, with only a little fidgeting or nervous movement ▸ some attempt to wear appropriate clothing for the occasion	▸ keeps eye contact with audience most of the time; only reads notes or slides sometimes ▸ uses hands naturally, making some gestures ▸ confident posture ▸ clothes are appropriate for the occasion	*In addition to At Standard criteria:* ✚ keeps eye contact all the time, slowly scanning all of the audience; does not read notes or slides ✚ uses gestures smoothly, naturally to emphasize or illustrate points ✚ moves with purpose
Speaking	▸ mumbles or goes too fast or slow ▸ speaks too softly to be heard ▸ frequently uses "filler" words ("uh, um, so, and, like") ▸ pronounces several words incorrectly ▸ speaks in a style that is not appropriate for the occasion	▸ speaks clearly some of the time; sometimes too fast or slow ▸ speaks loudly enough for some of the audience to hear, but may speak in a monotone ▸ occasionally uses filler words ▸ pronounces a few words incorrectly ▸ speaks in a style that is appropriate for the occasion, most of the time	▸ speaks clearly; not too fast or slow ▸ speaks loudly enough for everyone to hear; changes tone to maintain interest ▸ rarely uses filler words ▸ pronounces words correctly ▸ speaks in a style that is appropriate for the occasion	*In addition to At Standard criteria:* ✚ adds variety to speaking style (lower or higher volume, change of pace, use of character voices) ✚ uses pauses for dramatic effect or to let ideas sink in
Organization	▸ does not meet requirements for what should be included in the presentation ▸ selects too much or too little information or the wrong kind of information ▸ gets ideas mixed up ▸ time is not used well; the whole presentation, or several parts of it, are too short or too long ▸ does not have an introduction and/or conclusion	▸ meets most requirements for what should be included in the presentation ▸ sometimes selects too much or too little information, or the wrong kind, about some topics ▸ some ideas are connected, but not all ▸ some parts feel too short or too long; too much or too little time is spent on one topic, slide, or idea ▸ has an introduction and conclusion, but they are not clear or interesting	▸ meets all requirements for what should be included in the presentation ▸ selects the right amount and kind of information to present ▸ states main idea & moves from one idea to the next clearly, in an order that makes sense ▸ time is well spent; no part feels too short or too long ▸ has a clear and interesting introduction and conclusion	*In addition to At Standard criteria:* ✚ has a memorable introduction and conclusion ✚ connects introduction and conclusion (returns to a story, theme, or metaphor) ✚ effectively uses humor, stories, or metaphors
Audio/Visual Aids	▸ does not use aids (pictures, drawings, objects, posters, maps, recordings, slides, other electronic media, etc.)	▸ uses aids but they do not add much to, and may distract from, the presentation ▸ aids are hard to read or hear, or are messy (writing or graphics are not neat or sound is not clear) ▸ aids are not ready to use and are not smoothly brought into the presentation	▸ aids add to the presentation ▸ aids are easy to see and/or hear, and are neat ▸ aids are ready to use and included smoothly into the presentation	*In addition to At Standard criteria:* ✚ aids are especially creative and/or powerful ✚ shows skill in creating aids and/or using technology ✚ smoothly handles problems with aids and technological glitches, if they occur
Response to Audience Questions	▸ does not address the audience's questions; says little or goes off the topic	▸ may answer some of the audience's questions, but not clearly and/or completely ▸ may try to answer a challenging question by faking it	▸ answers audience's questions clearly and completely ▸ when asked a question he or she does not know the answer to, says "I don't know" or explains how the answer could be found	*In addition to At Standard criteria:* ✚ answers questions in a way that adds details, examples, or new points to the presentation ✚ smoothly handles questions that are unclear, off the topic, distracting, or challenging

COLLABORATION RUBRIC

(for secondary and upper elementary grades)

	Below Standard	Approaching Standard	At Standard	Above Standard
Responsibility for Oneself	▸ is not prepared and ready to work with the team ▸ does not do project tasks ▸ does not complete tasks on time ▸ does not use feedback from others to improve his/her work	▸ is sometimes prepared and ready to work with the team ▸ does some project tasks, but needs to be reminded ▸ competes some tasks on time ▸ sometimes uses feedback from others	▸ is prepared and ready to work with the team; is available for meetings and uses the team's communication system ▸ does what he or she is supposed to do without having to be reminded ▸ completes tasks on time ▸ uses feedback from others to improve his or her work	*In addition to* ***At Standard*** *criteria:* ✚ does more than what he or she has to do ✚ asks for additional feedback to improve his or her work, beyond what everyone has been given
Helping the Team	▸ does not help the team solve problems; may cause problems ▸ does not share ideas with other team members ▸ does not give useful feedback to others ▸ does not offer to help others	▸ cooperates with the team but does not actively help it ▸ makes some effort to share ideas with the team ▸ sometimes gives useful feedback to others ▸ sometimes offers to help others	▸ helps the team solve problems, manage conflicts, and stay focused and organized ▸ shares ideas that help the team improve its work ▸ gives useful feedback (specific and supportive) to others so they can improve their work ▸ offers to help others do their work if they need it	*In addition to* ***At Standard*** *criteria:* ✚ steps in to help the team when another member is absent ✚ encourages others to share ideas, helps to make them clear, and connects them to the team's work ✚ notices if a team member does not understand something and takes action to help
Respect for Others	▸ does not pay attention to what teammates are talking about ▸ does not show respect for teammates (may interrupt, ignore ideas, hurt feelings)	▸ usually listens to teammates, but not always ▸ is polite and kind to teammates most of the time, but not always	▸ listens carefully to teammates ▸ is polite and kind to teammates	*In addition to* ***At Standard*** *criteria:* ✚ encourages the team to be respectful to each other ✚ recognizes everyone's strengths and encourages the team to use them