Notes

Student Activity

Activity 4:
Biosolids Town Meeting

Subject Areas:
Theatre; Social Studies; English Language Arts; Government and Public Administration; Food, Agriculture and Natural Resources; and Environmental Science.

Behavioral Objectives:

1) The students will work to develop a positive personal value system when resolving biosolids issues in a public forum.

2) The students will demonstrate the research skills necessary to gather information to support their opinions on an issue.

3) The students will apply their interpersonal skills.

Activity:
Announce that the class is going to have a town meeting. Discuss what a town meeting is. If needed, have them research the political concept of a town meeting as a small local governmental unit that addresses individuals people's concerns where everyone may contribute to the decision making process (see example Town Hall Agenda). Inform the students that the town meeting is going to have a specific topic. That topic will be biosolids agricultural land application activities in the community.

Have the students research what biosolids are as well as what agricultural land application activities entail.
To direct the research, guide them to the EPA and State of Florida biosolids/residuals websites. Briefly discuss what biosolids/residuals or sewage treatment facility sludge products are and what land spreading of the fertilizer product (biosolids) involves.

Student Activity

Activity 4:
Biosolids Town Meeting *(continued)*

Next assign students to one of the various stakeholder roles using the cards provided in this section. Stakeholders by definition are defined as all the members or participants having an interest in an organization or cause. For a government entity, this can be a lot of different groups ranging from citizens to government representatives. Have the students use the stakeholder group cards or create some of your own. The roles provided are suggestions as many other stakeholders may exist depending on the region or area. For instance, if you live in an area with lots of tourism, a local tourism board or agency might be concerned about biosolids as it pertains to tourists. In other words, is the smell an issue because the land application site is next to a park or attraction? Are the hauling trucks blocking local roads or causing traffic congestion? Have tourists complained in online reviews about seeing "unsightly trucks?" After assigning roles, tell the students they are to begin researching their positions on biosolids (i.e. for or against). Some students will be strongly opposed to biosolids applications and they must be able to

Student Activity

Activity 4:
Biosolids Town Meeting *(continued)*

clearly present why they are opposed. Other students will be in favor of the beneficial use of biosolids and will need to be able to demonstrate clearly why they think residual agricultural land application activities are beneficial to the community. While there are many issues to consider, below is a list of a few issues you can present to the students in part or whole:

- The environment
- Public health
- Property values and land usage
- Possible odors
- Wastewater treatment operation costs
- Costs for maintaining, repairing and improving roads
- Transportation costs for biosolids to land application site
- Farmer and/or Rancher operation costs
- Public acceptance and community buy-in

Whatever roles the students are assigned, they must be well versed in their roles with a stance (either for or against) on the issue of biosolids land application.

The town meeting will commence with the town manager acting as moderator and guiding the discussion. The students will speak, when recognized by the moderator, giving their opinions and viewpoints. The discussion shall continue as long as needed to ensure people have had a chance to speak as often and as thoroughly as necessary. Rebuttals, points and counterpoints will help the discussion continue to an end point that the teacher will announce.

You may consider acting or assigning to a student, a non-participatory and unbiased role as the designated meeting minutes recorder (or Secretary) for the meeting. This role is responsible for taking minutes (or notes). After the discussion portion the class should compile the information with a

Student Activity

Activity 4:
Biosolids Town Meeting *(continued)*

vote for or against land application. A vote can be taken with a show of hands. After the vote count is announced the students should then be guided in a discussion of the potential ramifications of the vote. They should recognize that whatever they voted for at the town level has to be in compliance with other governmental rules. For example, should the students vote against land application, they need to know that the State and EPA allow land application and possibly their vote would not hold up in court. They might need to pass a local ordinance concerning biosolids land application that would be more stringent than the State and EPA regulations. Discuss the complications and ramifications of government at all levels while stressing that even at the town meeting level of government it is of great value to society for everyone to actively participate.

Student Activity

There is only one Town Manager.
All other roles can have multiple students assigned to them as needed.

COUNTY EMPLOYEE
(Local Government)

☐ For ☐ Against

TOWN COUNCIL MEMBERS

☐ For ☐ Against

LOCAL NEWS REPORTER

☐ For ☐ Against

TOWN MANAGER

☐ For ☐ Against

MEMBER OF PROMINENT ENVIRONMENTAL GROUP

☐ For ☐ Against

COLLEGE PROFESSOR
(Expert in soil fertility/ plant nutrition)

☐ For ☐ Against

MEMBER OF LOCAL TOURISM BOARD

☐ For ☐ Against

BIOSOLIDS HAULER
(Trunk driver)

☐ For ☐ Against

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Student Activity

EPA OFFICIAL
(Federal Government)

☐ For ☐ Against

DEP OFFICIAL
(State Government)

☐ For ☐ Against

RESIDENT
(Does not live near the application site)

☐ For ☐ Against

RESIDENT
(Lives near the application site)

☐ For ☐ Against

WASTEWATER TREATMENT FACILITY EMPLOYEE

☐ For ☐ Against

LAND OWNER
(Application site)

☐ For ☐ Against

Government
Resident
Business
Other

Make your own!!! Suggestions include:

- *Concerned Citizens*
- *School Administrators*
- *Those living/playing/working near application site*
- *Tourists/Seasonal Residents*
- *Scholars*
- *Local Water Authorities*
- *Non-profits*
- *Sales Groups*

_____

☐ For ☐ Against

_____

☐ For ☐ Against

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Student Activity

Example Town Hall Agenda
City/Town/County name here

- CALL TO ORDER/ROLL CALL/DETERMINATION OF A QUORUM
  This is the beginning of the meeting.
- PUBLIC COMMENTS
  This is usually when the floor is opened for public comments or questions.
- APPROVAL OF MINUTES
  This is where the minutes (or notes) from the last meeting are approved.
- CONSENT AGENDA
  This is where items are approved such as invoices and/or fund activities (finances).
- NEW BUSINESS
  This is where new items are introduced. These could be announcements like new hires, Board member expirations or appointments, actual expenses, and other business is presented.
- OLD BUSINESS This is where old items (i.e. items that were introduced in previous meetings or items that require follow up) are introduced.
- STAFF REPORTS, DISCUSSION, AND ACTION
  This is where designated staff members (titles might be Director, Manager, etc) make presentations and/or give briefings to the entire group. For instance, they may update the group on an issue that is ongoing and what actions are being taken.
- TRUSTEE REPORTS, DISCUSSION, AND ACTION
  This is where Trustees (if applicable) make presentations and/or give briefings to the entire group.
- ADJOURNMENT
  This is when the meeting is declared over or adjourned.

NEXT MEETING DATE: MM DD YYYY at Time (AM or PM)

Student Activity

Activity 4:
Biosolids Town Meeting *(continued)*

Evaluation Options:

1. Quantitative evaluation by grading a student's descriptive writing assignment for each of the assigned portrayal roles.
2. Qualitative evaluation of the student's active participation in their town meeting roles.
3. Mastery evaluation by the students successfully writing a brief summary of the meeting in terms of what a town meeting means to them personally.

Florida Standards

SS.8.G.3, SS.8.G.5, SS.8.G.6, SS.8.E.1, SS.8.C.1, SS.8.C.2, SS.912.G.2, SS.912.G.3, SS.912.G.5, SS.912.G.6, SS.912.E.1, SS.912.C.1, SS.912.C.2, SS.912.C.3, SS.912.S.3, SS.912.S.4, SS.912.S.6, SS.912.S.8, TH.68.C.1, TH.68.H.3, TH.68.F.1, TH.912.C.1, TH.912.S.2, TH.912.H.2, TH.912.H.3, TH.912.F.1, SC.912.CS-PC.2, SC.912.CS-PC.3, SC.912.CS-CC.1, SC.8.N.4, SC.912.N.4

Notes

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Student Activity

Activity 5:
Letter and Email Writing

Subject Areas:
English Language Arts; Social Studies; Government and Public Administration; and Environmental Science.

Behavioral Objectives:

1) The students will be presented with perspectives differing from their own on biosolids land applications.
2) The students will demonstrate a good expository writing style in their letters and/or emails.
3) The students will practice using their investigative skills to seek information and become more informed decision makers.

Activity:
Begin by informing the students that a biosolids company called "ThereYouGrow" is going to begin working with their local county to build a new $13,000,000 facility that turns treated sewage into biosolids Class AA fertilizers. This fertilizer will be marketed and sold. This announcement has received a lot of negative publicity. The announcement was featured on the page of a major social media influencer and environmentalist who goes by the alias, "GoGreen4Earth while this influencer's intentions (to help the Earth) are good, this person's 5 minute video post which has gained 3 million views in a week, is full of opinions and little to no facts. This influencer titled his/her/their post, "[Insert local county] is selling untreated sewage for profits." The publicity has created a backlash in the community and has many people taking sides. Explain to the students that many community members, including their neighbors and even relatives are upset, angry, and scared. To make matters worse, the [Insert local county] social media is filled with "trolls" and posts made by uninformed citizens.

Student Activity

Activity 5:
Letter and Email Writing *(continued)*

Explain to the students that constructing and operating a biosolids fertilizer facility may impact the students' lives in many ways. For instance, the negative impacts may include increased truck traffic; possible offensive odors; and increased sewer/utility bills. The potential positive impacts may include lower chances of disease transmission (less pathogens in fertilizer), profits to the utility/wastewater treatment facility for marketing and selling fertilizer, and less impact to landfills for disposal. In this situation, explain to the students that the county's decision to build and operate a facility was because its population has been booming, the landfill is filling quickly, and this will help the county financially as they will be selling the fertilizer.

Tell the students that they work as freelance journalists for a public news company that wants to cover this developing story on their television, social media, and website. While many students may be openly in support or against land application, the goal of this assignment is to gather accurate and unbiased information. This information may change a student's former view on the issue! Towards the end of this activity, you will find a list of possible contacts that the students may hypothetically contact to get more information. Remind the students that the goal of their journalistic investigations is to find the true information, not just what they think supports their views. In other words, ask the students to try doing research that is in support and against their personal opinions (if they have any).

To begin the assignment, ask the students to write down a list of questions and/or concerns they may have about the construction and/or operation of the fertilizer facility. For instance, they may question the safety or legality of the operation, the impact of the community (crowded roads, unpleasant odors), and/or the impact on the environment. They

Student Activity

Activity 5:
Letter and Email Writing *(continued)*

may also be curious how much money the operation will cost, who's paying for it and who's operating it. You may want to guide the students towards doing some preliminary research on the pros and cons of producing Class AA fertilizers in Florida, so that they can compare other options for biosolids (Class AA fertilizers versus landfill for instance).

Tell the students that they are then to research the names, titles, organizations, and addresses (or email addresses) of the individuals that may be able to help them gather information about this developing story by answering their above questions. In other words, can they apply their investigative skills to identifying some experts or other knowledgeable individuals to help them find the information needed to make an educated and truthful news report?

Challenge the students to search through government websites (local, state and possibly federal) to identify the right individuals, departments, and/or organizations. For instance, students might discover that their local wastewater treatment facilities are operated by a utility that belongs to local government. They often go by "Water and/or Sewer" department, division, or utility.

Student Activity

Activity 5:
Letter and Email Writing *(continued)*

After identifying a few contacts, assign the students to write a letter or email to one or more of these individuals requesting more information or specific answers to their questions. The students are investigative journalists, so their questions will help steer the upcoming news story; hopefully in an honest and unbiased direction from the last bad (and incorrect) one.

Remind the students that these letters and/or emails should not be sent to the actual addressees as they may cause confusion. Tell the students that the recipients of these emails are professionals and they should write their letters and/or emails in a professional tone using proper grammar, spelling, and punctuation. Also remind the students that as employees of the local news, they must conduct themselves in a courteous and professional manner because reputation is important, both to themselves professionally and to the news company.

Once the letters or emails have been written, the students may share them with the others to generate a dialogue. Ask the students why they chose to write their letters and/or emails to who they did. Were there any others (i.e. experts) they found that weren't on the list? Tell the students that normally, reporters do similar research when putting together stories or news reports- investigating contacts (or leads) and then scheduling interviews to ask their questions. Usually interviews are done over the phone, over an online platform like Zoom or Microsoft Teams or in person with a camera recording. While letters and emails were used in this assignment, they take too long for correspondence when reporters are often working under tight deadlines.

Student Activity

Activity 5:
Letter and Email Writing *(continued)*

Suggested People or Organizations to contact

This list is not all inclusive as the titles and roles vary from county to county (and even in cities and villages, etc) in Florida. If students are struggling, try having them research their local utility starting with the closest town, village or city nearby. Many smaller municipalities may have less information available online so you may also suggest trying the nearest large city or a metropolitan area like Tampa Bay, Orlando, Miami, etc.

Local Government officials:	***State Government Officials:***
• Commissioners • City or Village Manager • Wastewater Treatment Facility Manager, Director, or Superintendent • Utilities' Director, Manager, or Superintendent	• FDEP (for permitting) • Governor
Local News Media and other Influencers:	***Biosolids Operations:***
• News Reporters • Attorneys • Local newspaper • Local Blogger or social media influencer (must be local and focused on environmental issues)	• Hauling company Manager, Director, or Head of local Operations • Farmer or Rancher who operates the land application site
Federal Government officials:	***Other possibilities:***
• EPA Director • An employee with "Water" and/or "Biosolids" in their formal title	• Academics such as college professors or researchers • Wastewater Engineers • Local farmers or Ranchers • Professional associations like the Florida Water Environment Association • Textbook or biosolids publications authors (try an internet search for "biosolids publications")

Student Activity

Activity 5:
Letter and Email Writing *(continued)*

Evaluation Options:

1) Quantitative evaluation of of the letters for correct grammar, spelling, punctuation and sentence structure.
2) Quantitative evaluation of the research methodologies used by the students to pose questions and find the appropriate contacts/experts.
3) Quantitative evaluation of the research methodologies used by the students to pose questions and find the appropriate contacts/experts.

Florida Standards:

ELA.8.R.2, ELA.8.R.3, ELA.8.C.1, ELA.8.C.2, ELA.8.C.3, ELA.8.C.4, ELA.8.C.5, ELA.8.V.1, ELA.9.R.2, ELA.9.R.3, ELA.9.C.1, ELA.9.C.2, ELA.9.C.3, ELA.9.C.4, ELA.9.C.5, ELA.9.V.1, ELA.10.R.2, ELA.10.R.3, ELA.10.C.1, ELA.10.C.2, ELA.10.C.3, ELA.10.C.4, ELA.10.C.5, ELA.10.V.1, ELA.11.R.2, ELA.11.R.3, ELA.11.C.1, ELA.11.C.2, ELA.11.C.3, ELA.11.C.4, ELA.11.C.5, ELA.11.V.1, ELA.12.R.2, ELA.12.R.3, ELA.12.C.1, ELA.12.C.2, ELA.12.C.3, ELA.12.C.4, ELA.12.V.1, LAFS.8.RL.1, LAFS.8.RI.1, LAFS.8.RI.4, LAFS.8.SL.1, LAFS.8.SL.2, LAFS.8.W.1, LAFS.8.W.2, LAFS.8.W.3, LAFS.8.L.1, LAFS.8.L.2, LAFS.8.L.3, LAFS.910.RL.1, LAFS.910.RI.1, LAFS.910.RI.2, LAFS.910.RI.3, LAFS.910.RI.4, LAFS.910.W.1, LAFS.910.W.2, LAFS.910.W.3, LAFS.910.SL.1, LAFS.910.SL.2, LAFS.910.L.1, LAFS.910.L.2, LAFS.910.L.3, LAFS.910.RH.2, LAFS.910.RH.4, LAFS.910.RST.1, LAFS.910.RST.2, LAFS.910.RST.4, LAFS.910.WHST.1, LAFS.910.WHST.2, LAFS.910.WHST.3, LAFS.1112.RL.1, LAFS.1112.RI.1, LAFS.1112.RI.2, LAFS.1112.RI.3, LAFS.1112.RI.4, LAFS.1112.W.1, LAFS.1112.W.2, LAFS.1112.W.3, LAFS.1112.SL.1, LAFS.1112.SL.2, LAFS.1112.L.1, LAFS.1112.L.2, LAFS.1112.L.3, LAFS.1112.RH.1, LAFS.1112.RH.3, LAFS.1112.RH.4, LAFS.1112.RST.1, LAFS.1112.RST.3, LAFS.1112.RST.4, LAFS.1112.WHST.1, LAFS.1112.WHST.2, LAFS.1112.WHST.3, SS.8.E.1, SS.912.E.1, SS.8.C.1, SS.912.C.2, SS.912.C.3, SC.8.N.4, SC.912.N.1, SC.912.N.4, SC.912.E.6, SC.912.E.7, SC.912.CS-PC.2, SC.912.CS-PC.3

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Student Activity

Activity 6:
Biosolids Growth Experiments

Subject Areas:
Biology; Environmental Science; Earth Science; Chemistry; Home Economics; Food, Agriculture and Natural Resources; and Mathematics.

Behavioral Objectives:

1) The students will utilize the scientific method to research the effects of biosolids fertilizers on plant growth.

2) The students will utilize the research skills need to conduct experiments such as designing experiments, observing, recording data, synthesizing information, producing graphs, and presenting results.

3) The students will employ the mathematical skills necessary to present data, including the usage of metric units.

Activity :
Begin the class by asking the students, "What is a fertilizer and what are fertilizers made of?" The students may or may not recognize that fertilizers are derived from two sources: organic and inorganic ones. A very simple and relevant example for helping guide students towards recognizing organic sources is to ask them what happens after a dog defecates on the grass and no one picks it up. After a few days, the dog poo will disappear and the surrounding grass will be greener. This is because the poo is an organic (or naturally derived from carbon) fertilizer source that contains nutrients like nitrogen that make the grass greener. City ordinances requiring picking up dog poo are primarily based on prevent-

Activity 6:
Biosolids Growth Experiments

ing nutrients from getting into natural waters. Additionally, disease-carrying vectors like flies may get into the dog poo. Ask the students what other kinds of nutrients are required by plants for survival. These nutrients are often broken into two groups: macro and micro, depending upon the quantity needed by plants. Nitrogen (N), phosphorus (P), and potassium (K) are the most commonly recognized macronutrients and are found as the three numbers on any fertilizer label. You may ask the students to visit a local home improvement store (or where home/retail fertilizers are sold) to take pictures or record what the nutrients contained in fertilizers are. Included in Activity 8 are some sample fertilizer labels that can be substituted for a visit to a home improvement store.

Explain to students how historically, fertilizers have been derived from either organic (animal or plant) or inorganic (synthetically made chemicals). Be sure to point out to students that organic sources are made from recycled processes, by nature. In other words, these materials must be decomposed by other living organisms like soil microbes. Propose a discussion of the wastes of people as a possible source of fertilizers. Remind them of the ancient practice of using untreated human wastes called "night soil" as a fertilizer for the rice paddies in Asia. Inform the students that for public health and environmental protection, this country does not advocate the use of untreated human wastes. In the US, treated human waste products made into beneficial soil amendments is encouraged and is heavily regulated by law. Ask the students to research and understand what Class AA biosolids are and how they are available at many stores.

Student Activity

Activity 6:
Biosolids Growth Experiments *(continued)*

Next, have the students design a science fair style-project (tri folding board is optional for presentation) to compare a Class AA biosolids fertilizer to a chemical fertilizer. Class AA fertilizers can be found commercially at local home improvement stores often under different brand labels or by reading the fertilizer ingredients (often slow release or natural formulations) for the word, "biosolids." Remind the students that in order to follow the scientific method (as well as Florida science fair guidelines), their project must contain at a minimum:

- A research question such as, "What is the effect of different fertilizer types on plant height?"
- Identification of variables: dependent versus independent variables
- Use of a control group (i.e. no fertilizer applied)
- A list of materials used
- Set-up conditions
- Step by step directions that can be replicated by anyone
- Prediction or hypothesis
- Data (usually graphs). Photos are also great to capture qualitative data. Photos should not be used in lieu of graphs but together.
- Results
- Explanation
- Real World uses relating to this research
- Data log or scientific journal for daily observations, questions, trials and errors, etc. Optional but required for state wide science fair projects.

Student Activity

Activity 6:
Biosolids Growth Experiments *(continued)*

Remind the students the goal of this activity is to compare the growth of plants (they choose) grown using organic versus inorganic fertilizers. Guide the students towards designing an experiment that answers their research question.

An example of a rubric used for scoring science fair projects can be found at the conclusion of this activity.

Evaluation options:

1. Quantitative evaluation by grading the students ability to follow the science fair guidelines posted above.

2. Qualitative evaluation by observing and recording student individual participation in the experiments.

3. Mastery evaluation by each student completing levels of the project such as helping in the research, constructing growth containers, monitoring and recording the experiment progression, calculating statistics, and producing a report.

Science Showcase Rubric 2019/2020
Small group or Individual projects

Using the Rubric: Begin in the left hand column (Required Elements). Mark each category by circling the description that best matches the project, and record that numeric score in the score box. Multiply each score with its weighting factor (wt column) to get a final score. Total the final scores to the bottom.

Required Elements	0	1 Point	2 Points	Score	Wt	Final Score
Research Question (A question that explains what was studied)	ELEMENT NOT PRESENT OR NOT SCOREABLE	States a research question; but inaccurate, incomplete, or lacks enough detail.	Accurately states research question: includes cause and effect (x and y), and provides ample detail to investigate project.		**x 3**	
Predictions (Lists the three possible outcomes of the experiment and identifies the outcome that will most likely occur)		States one or more predictions; but inaccurate, or incomplete, or lacks enough detail to follow. .	Accurately states three predictions that include cause and effect (x and y); Clearly identifies the most likely outcome.		**x 3**	
Independent Variable (Describes the one thing that the students changed)		States what will be changed but with inaccurate or incomplete details.	Accurately states what will be changed with enough detail to assure accuracy.		**x 3**	
Dependent Variable (Describes what the students measured)		States what will be measured but inaccurate or incomplete details.	Accurately states what will be measured with enough detail to assure accuracy.		**x 3**	
Control Group (Describes the set of data measured under normal conditions***)***		Identifies the set of data that will be measured under normal conditions but is inaccurate.	Accurately states the set of data that will be measured under normal conditions.		**x 4**	
Set-Up Conditions (List all of the things that were kept constant)		Lists some constants; some inaccurate or incomplete.	Lists all necessary constants with good detail and description of set-up.		**x 3**	
Materials List (List of all of the items that were used to complete the experiment)		Lists partial, confusing, or inaccurate materials; or lacks quantities or measurements.	Lists complete set of materials; sufficient detail to duplicate directions. (metric)		**x 3**	
Procedures (List of steps in order of exactly what was done)		Gives partial, confusing or non-sequential directions; or lacks enough detail to follow.	Gives complete list of procedures with detail such that the experiment could be duplicated by another. (metric & safety)		**x 3**	
Data Collection (Chart with the data that was measured in the experiment)		Most data shown; some data missing, or not organized in chart form, or missing units or averages.	Proper chart shown with complete data; 10 or more trials and averages; all units, labels, and detail present.		**x 5**	
Graph (Mathematical picture of the data)		Graph shown; some elements incomplete or inaccurate.	Proper graph shown; all elements complete and accurate.		**x 5**	
Results (Tells what happened with the data using mathematical language)		Lists some results; some statements inaccurate or incomplete.	Lists at least three mathematical results accurately and with detail.		**x 3**	
Explanation (Summary of findings that evaluate the experimental procedure and provides scientific reason that supports experiment findings)		Explanation statement present but inaccurate or incomplete.	Explanation is accurate and provides specific scientific detail related to experiment.		**x 4**	
Real World Uses **relating to Research** (Ways that the information might be used)		States one or more uses; but incomplete, inaccurate, or lacks details.	States three or more possible uses related to the research question; with good detail.		**x 3**	
Science Journal		Some elements are missing, incomplete or inaccurate.	All elements present, accurate, good detail and few errors; dated narrative present.		**x 2**	
Display Board		Some elements are missing, incomplete or inaccurate.	All elements present and accurate with good detail and few errors.		**X 3**	

Comments:

Total Score
/100

Student Activity

Activity 6:
Biosolids Growth Experiments *(continued)*

Florida Standards:
SC.8.L.18, SC.8.N.1, SC.8.N.3, SC.8.N.4, SC.912.L.14, SC.912.L.17, SC.912.L.18, SC.912.E.6, SC.912.E.7, SC.912.N.1, SC.912.N.4, SS.8.E.1, SS.8.E.2, SS.912.E.1, SS.912.E.2, MAFS.8.EE.2, MAFS.8.G.3, MAFS.912.N-Q.1, MAFS.912.G-GMD.2, MAFS.912.G-MG.1, MAFS.912.S-MD.2, MA.8.GR.2, MA.8.DP.2, MA.912.FL.2, MA.912.GR.1, MA.912.GR.4, MA.912.GR.5, MA.912.DP.1, MA.912.DP.4, MA.912.DP.5, LAFS.8.RL.1, LAFS.8.RL.2, LAFS.8.RL.4, LAFS.8.RI.1, LAFS.8.RI.2, LAFS.8.RI.3, LAFS.8.RI.4, LAFS.8.W.1, LAFS.8.W.2, LAFS.8.W.3, LAFS.8.L.1, LAFS.8.L.2, LAFS.8.L.3, LAFS.910.RL.1, LAFS.910.RL.2, LAFS.910.RL.4, LAFS.910.RI.1, LAFS.910.RI.2, LAFS.910.RI.3, LAFS.910.RI.4, LAFS.910.W.1, LAFS.910.W.2, LAFS.910.W.3, LAFS.910.L.1, LAFS.910.L.2, LAFS.910.L.3, LAFS.910.RH.1, LAFS.910.RH.2, LAFS.910.RH.3, LAFS.910.RH.4, LAFS.910.RST.1, LAFS.910.RST.2, LAFS.910.RST.3, LAFS.910.RST.4, LAFS.910.WHST.1, LAFS.910.WHST.2, LAFS.910.WHST.3, LAFS.910.WHST.4, LAFS.1112.RL.1, LAFS.1112.RL.2, LAFS.1112.RL.4, LAFS.1112.RI.1, LAFS.1112.RI.2, LAFS.1112.RI.3, LAFS.1112.RI.4, LAFS.1112.W.1, LAFS.1112.W.2, LAFS.1112.W.3, LAFS.1112.L.1, LAFS.1112.L.2, LAFS.1112.L.3, LAFS.1112.RH.1, LAFS.1112.RH.2, LAFS.1112.RH.3, LAFS.1112.RH.4, LAFS.1112.RST.1, LAFS.1112.RST.2, LAFS.1112.RST.3, LAFS.1112.RST.4, LAFS.1112.WHST.1, LAFS.1112.WHST.2, LAFS.1112.WHST.3, ELA.8.R.2, ELA.8.R.3, ELA.8.C.1, ELA.8.C.3, ELA.8.C.4, ELA.8.C.5, ELA.8.V.1, ELA.9.R.2, ELA.9.R.3, ELA.9.C.1, ELA.9.C.3, ELA.9.C.4, ELA.9.V.1, ELA.10.R.2, ELA.10.R.3, ELA.10.C.1, ELA.10.C.3, ELA.10.C.4, ELA.10.V.1, ELA.11.R.2, ELA.11.R.3, ELA.11.C.1, ELA.11.C.3, ELA.11.C.4, ELA.11.V.1, ELA.12.R.2, ELA.12.R.3, ELA.12.C.1, ELA.12.C.3, ELA.12.C.4, ELA.12.V.1

Notes

Notes

Student Activity

Activity 7:
Map Making

Subject Areas:
Earth Science; Visual Arts, Geography; History; Environmental Science; Mathematics; and Geographic Information Systems (GIS).

Behavioral Objectives:

1) The students will create maps that follow the setback distances required for biosolids land application sites.

2) The students will learn to identify the features on a map that require setback distances such as wells, surface waters, and property lines.

3) The students will display the psychomotor skills necessary for the creation of a biosolids land application site map.

Activity:
In this activity the students will use aerial agricultural site maps or the provided maps to understand the compliance issues involved with farmers and/or ranchers using their property for biosolids land application. Depending on the biosolids class, the teacher will need to provide some background information to the students concerning the beneficial use of an agricultural site for biosolids land application with its soil amendment benefits. For instance, Class B biosolids have restrictions related to their distances applied from occupied buildings, harvesting and grazing activities because they may contain pathogens.

Student Activity

Activity 7:
Map Making *(continued)*

Different biosolids have restrictions for use and the maps will show those restrictions. In Florida, there are rules or "Florida Administrative Codes, FAC," for the correct land use of different biosolids. When referencing these rules, refer to F.A.C 62-640. When land applied, biosolids can be used in different ways:

- Spread on the soil surface
- Mixed into the soil (incorporated)
- Stored or stockpiled
- Injected (applied below the soil surface)

Depending on the usage of the biosolids (i.e. spread on soil surface, injected, stored, etc), there are setback distances that apply to land applications. This helps to protect water sources from potential nutrients (like nitrogen and phosphorus) from running into them and potentially causing eutrophication. The table on the next page summarizes the setbacks that apply at a site. Note that Class B biosolids have additional setbacks due to pathogens. Class AA biosolids registered as a fertilizer or compost do not require setbacks on the maps.

Student Activity

Activity 7:
Map Making *(continued)*

Setback feature	Biosolids usage type	Distance (in feet)
Class I water, outstanding Florida Water, or Outstanding National Resource Water; setback is vegetated	All	1,000
Other surface water, setback is vegetated	All	200
Other surface water, setback is vegetated	Incorporated or injected	100
Subsurface fractures, sinkholes, or other conduits to groundwater	All	200
Private potable well	All	300
Public Potable well	All	500
Occupied buildings	Stored or stockpiled for 7+ days	1,320
Occupied buildings	Class B only	300
Occupied buildings	Class B only; incorporated or injected	100
Property lines	Class B only	75

This activity can be completed by groups or individually. In either case, the students can either create maps using an internet search or an application like Google Maps® to create a satellite view of an area of interest or use the maps created on the following pages.

Explain to the students that they own a land application company named "ThereYouGrow" and that they are going to use an agricultural property for biosolids land application (surface applied, not incorporated, injected or stored). Using one of the maps from the following pages or obtained

Student Activity

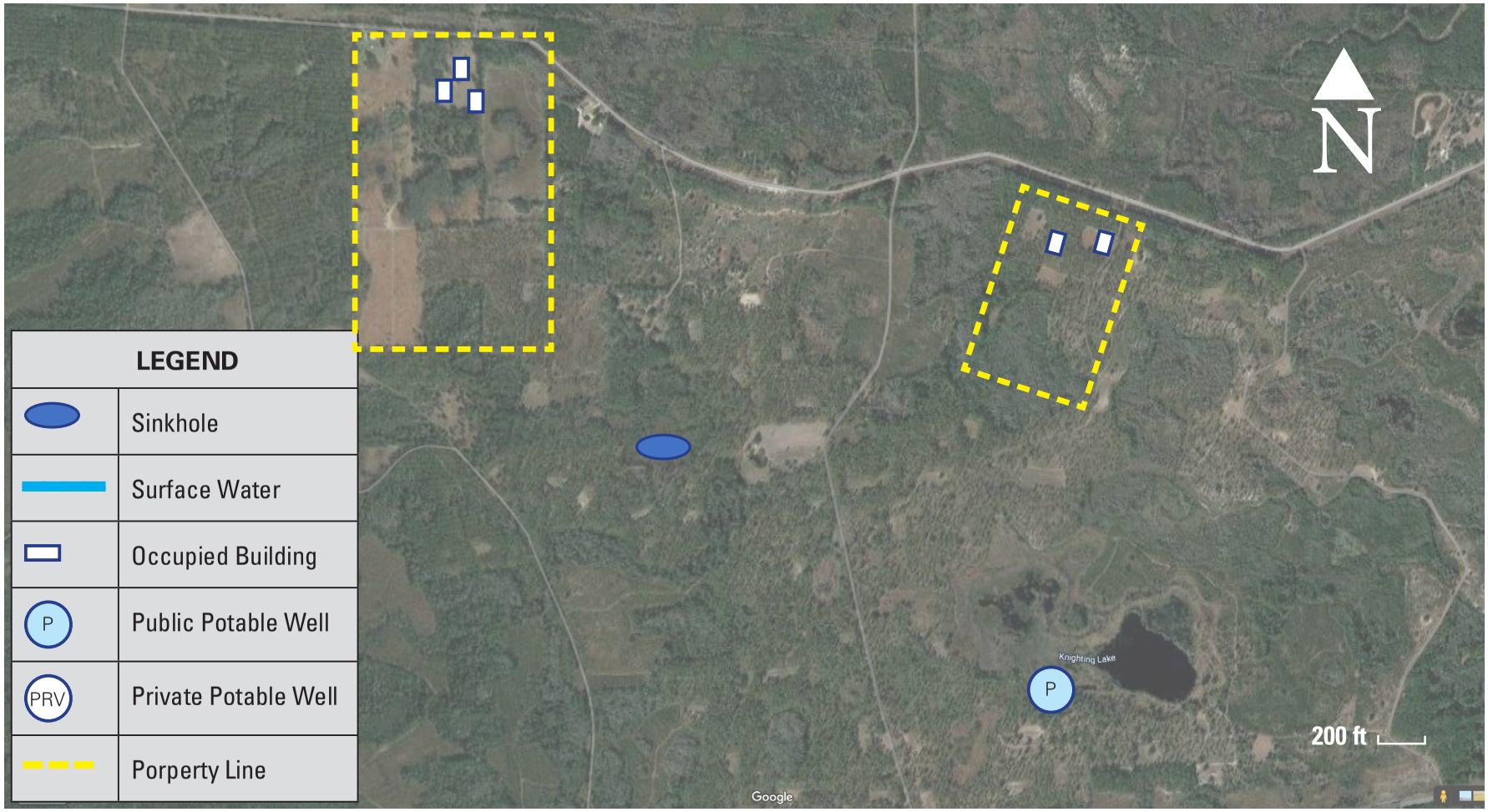
Activity 7:
Map Making *(continued)*

elsewhere (you decide), tell them they are going to create the appropriate setback areas using the table above. To successfully complete this project, the students must:

- Use the setback table above. If using the included maps (next pages), the table also includes color assignments and a legend for symbols on the provided maps.
- Shade in the setback areas. We recommend using colored pencils, crayons, or markers.
- Create a legend for the different colors (i.e. blue is for 100ft, red is for 1000 ft, etc.) on their map.
- Create a compass (students can assume the top of the page is north) on their map.
- Use a scale (i.e. 1 inch is equal to 200 feet) on their map.
- If using your own maps, you will need to create scenarios about the biosolids usage (i.e. incorporated or injected), types of waterbodies (i.e. Class one), property lines, etc.

After completing their maps, ask the students if their assigned areas or maps were well suited for land application sites. Explain to students that there are many pressures put on land applicators as population growth means more solids but also less land (increasing land application). Ask students if locally (can be around a neighborhood, school, or other point of interest), an application site would be feasible or not.

Student Handout #1



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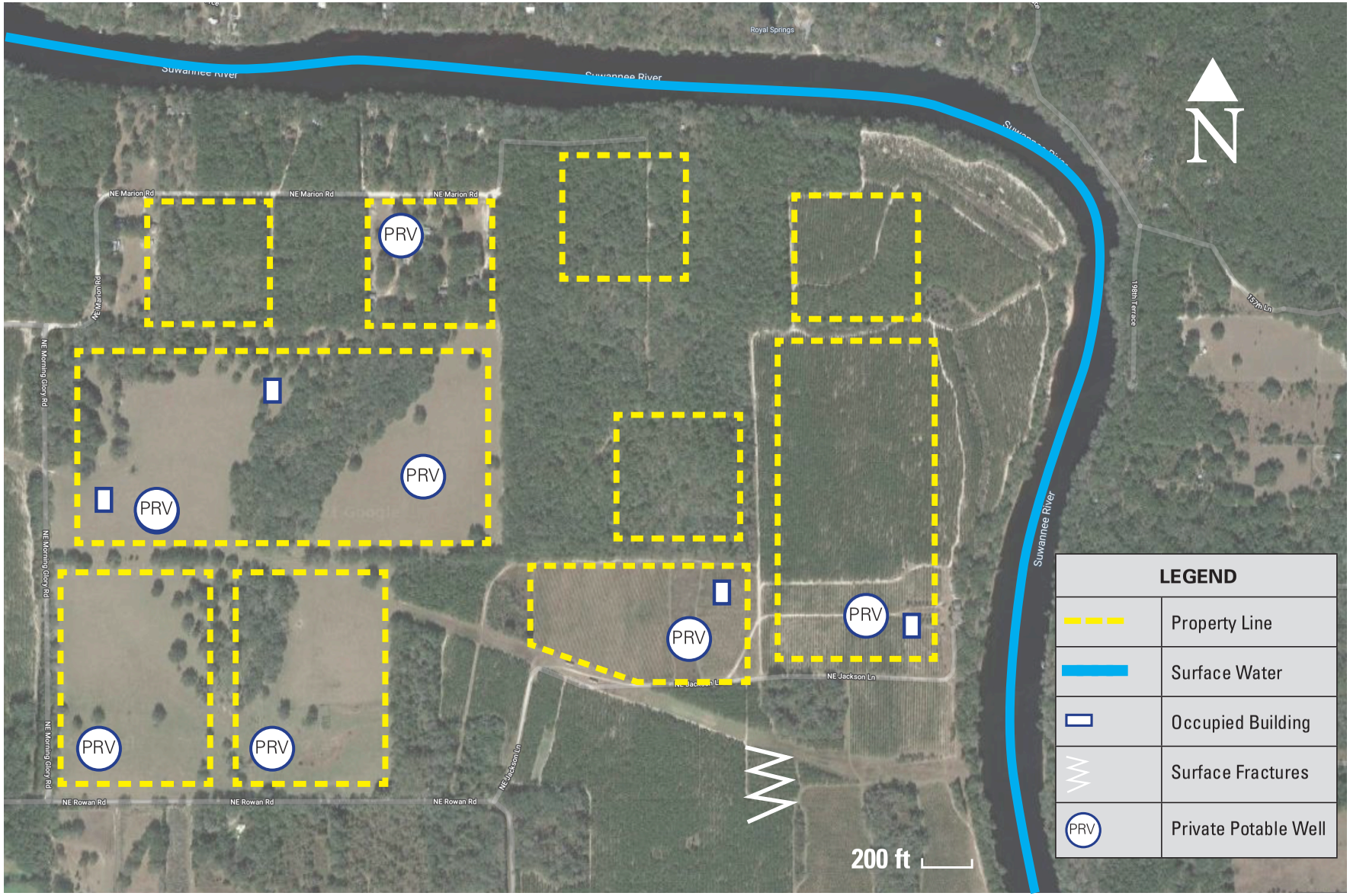
Student Handout #2



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Student Handout #3

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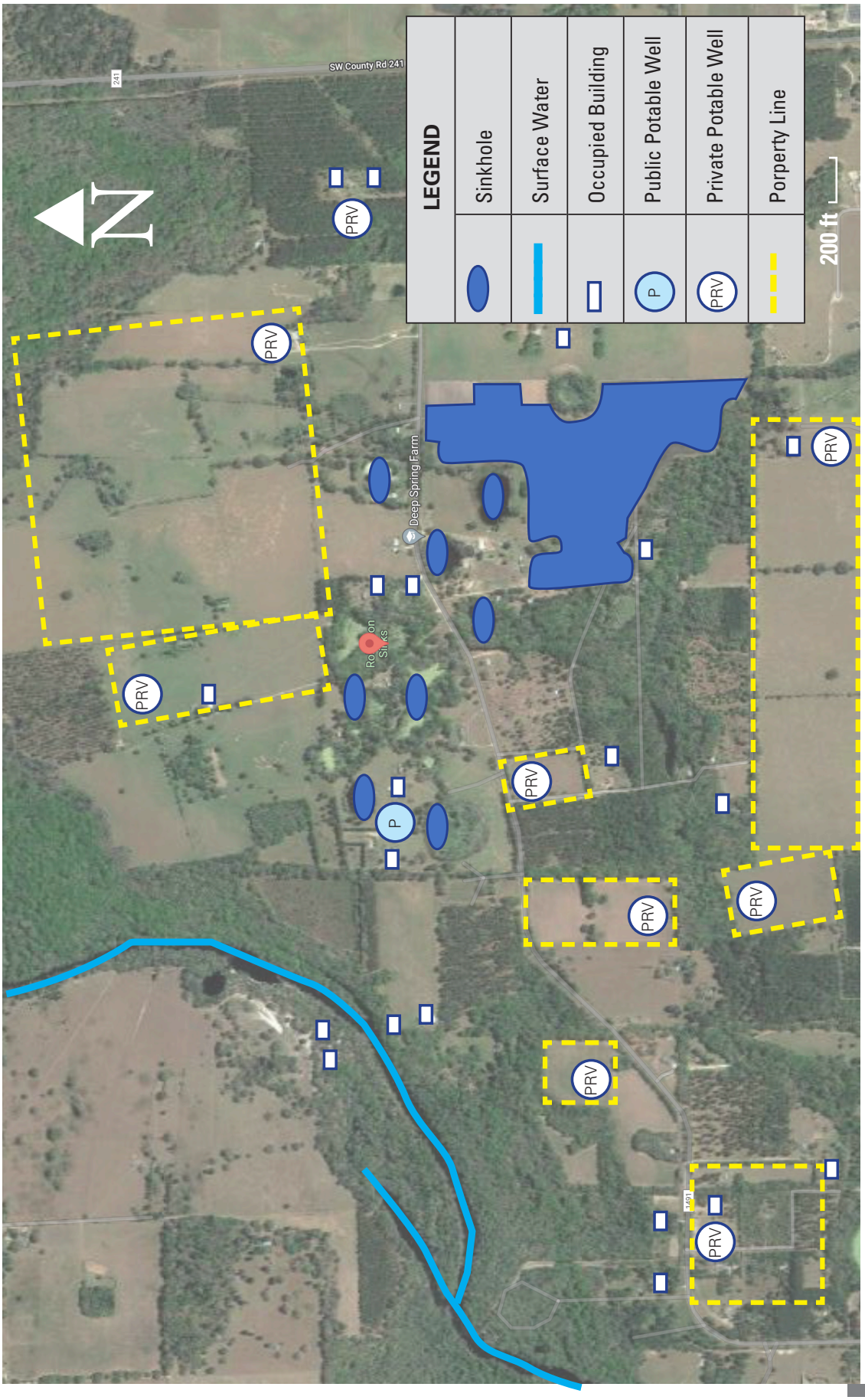
Student Handout #4



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Student Activity

Activity 7:
Map Making *(continued)*

Evaluation Options:

1. Quantitative evaluation by grading each student's map or a quiz designed with a model map that demonstrates a student's knowledge of the setback requirements. An example would be a 200 foot setback from waters of the State.

2. Qualitative evaluation may be measured by observing the student's attention to precision when marking off the setback distances on the map.

3. Mastery evaluation is obtained by each student successfully completing the mapping task and including the basic components of any map such as a scale, a compass, and a legend.

Florida Standards:
SC.8.L.18, SC.8.N.1, SC.912.L.17, SC.912.N.1, VA.68.C.1, VA.68.C.2, VA.68.S.1, VA.68.S.2, VA.68.S.3, VA.68.O.3, VA.68.H.2, VA.68.H.3, VA.68.F.3, VA.912.C.1, VA.912.C.2, VA.912.S.1, VA.912.S.2, VA.912.S.3, VA.912.O.3, VA.912.H.2, VA.912.H.3, VA.912.F.3, SS.8.G.1, SS.8.G.2, SS.8.G.3, SS.8.G.6, SS.912.G.1, SS.912.G.2, SS.912.G.3, SS.912.G.6, SS.8.G.5, SC.912.L.18, SC.912.N.4, SS.912.G.5, MAFS.8.G.3, MAFS.912.G-C.1, MAFS.912.G-C.2, MAFS.912.G-GMD.2, MAFS.912.G-MG.1, MA.8.GR.1, MA.8.GR.2, MA.912.GR.1, MA.912.GR.2, MA.912.GR.3, MA.912.GR.4, MA.912.GR.5, MA.912.GR.6, SC.912.CS-PC.2, SC.912.CS-PC.3, SC.912.CS-CS.3, SC.912.CS-CP.1

Notes

Student Activity

Activity 8:
Fertilizer Comparison Shopping

Subject Areas:
Home Economics; Mathematics; Earth Science; Food, Agriculture and Natural Resources; Chemistry; and Biology.

Behavioral Objectives:

1) The students will compare and contrast fertilizer characteristics and costs with biosolids products.

2) The students will organize a table to obtain the data needed for the comparison study.

3) The students will list fertilizer products by characteristics and cost.

Activity :
Let the students know that since it is "growing season" year round in Florida that they are going to decide what fertilizer product would be best for their home use. Since there are so many products on the market, how would they decide which product(s) to use? Using the fertilizer labels on the next pages, ask the students what are things they see in

Student Activity

Activity 8:
Fertilizer Comparison Shopping *(continued)*

common or things they notice every label has? For instance, every label must have a weight, a price, a guaranteed analysis (nutrient percentages), directions for use, and ingredients ("derived from"). As a class, guide the students into creating a table to compare the different types of fertilizers.
An example of a table might look like this:

Product Name	Price	Weight	Guaranteed Analysis (N-P-K)	Chemical or Biosolids?

Have the students begin by researching what are the characteristics of a good fertilizer. The guaranteed analysis (or nutritive values) are of paramount importance as they list the amount of plant available nutrients. The N-P-K or nitrogen, phosphorus, and potassium values are three macronutrients needed in the largest quantities by plants. Looking at the fertilizer labels, you will see that this ratio changes from formulation to formulation, depending on the intended usage (plant type or crop). If any micronutrients are present in the fertilizer, they will also present on the label. Have the students identify which nutrients in the fertilizer are macro and which are micro. Chemical fertilizers do not usually contain micronutrients.

Biosolids fertilizer and compost fertilizers are derived from natural, organic sources. They often contain micronutrients as well as humus. Humus is the dark organic soil component that is made from dead and decaying organic matter (can be

Student Activity

Activity 8:
Fertilizer Comparison Shopping *(continued)*

plant or animal). Humus adds value to soils by helping them retain water and water-soluble nutrients in the soil. This is especially beneficial in Florida's sandy soils where water moves very quickly between the larger soil particles. Chemical fertilizers typically have no humus. Guide the students towards recognizing the benefits of biosolids-based fertilizers. Working individually or in groups, have the students compare fertilizer labels using either the ones provided on the following pages or by visiting a local garden center and taking pictures of the labels. Students may compile and analyze their data in tables, charts, graphs or diagrams.

FRONT

Floriland®

Floriland®: Helping Florida grow since 1845

FERTILIZERS FOR FLORIDA GARDENS

FRUIT
FERTILIZER

Promotes higher fruit yields for Oranges, Tangelos, Tangerines, Lemons, Limes, Mangos, Avocados and most other Subtropical Fruits.

6-4-6

$12.98

Nt. Wt. 20 lbs. (9.07 kg)

BACK

Floriland®

Floriland®: Helping Florida grow since 1845

FERTILIZERS FOR FLORIDA GARDENS

FRUIT FERTILIZER

This fertilizer helps grow larger fruits and more blooms for bountiful harvests.

DIRECTIONS FOR USE:

FRUITING TREES AND PLANTS

AMOUNT TO USE: Apply ½ cup (or 4 oz) for every 3 feet of plant height to the base of the plant, tree, vine, or annual. Avoid applying fertilizer directly to the plant leaves. Water in lightly.

TIME TO USE: Apply at the beginning of Spring and every 45 – 60 days during the growing season. Avoid applying fertilizers during dormant months in the northern regions of the state.

HOW TO USE: Apply the fertilizer granules in a circle around the base of the plant using a scoop or cup. Wear gloves when handling. Avoid spreading the fertilizer past the longest reaching branches on the tree or plant. Water in lightly. Avoid applying fertilizers near lakes, streams, rivers or other bodies of water.

Please check local ordinances before fertilizing!

GUARANTEED ANALYSIS F-99

Total Nitrogen* (N)	6.00%*
1.00% ..... Ammoniacal Nitrogen	
4.10% ..... Water Soluble Nitrogen	
0.90% ..... Water Insoluble Nitrogen	
Available Phosphate (P_2O_5)	4.00%
Soluble Potash (K_2O)	6.00%
Total Magnesium as Mg	1.20%
1.20% ..... Water Soluble Magnesium as Mg	
Boron as B	0.02%
Chlorine (Cl) not more than	4.00%
Total Copper as Cu	0.05%
Total Iron as Fe	0.70%
Total Manganese as Mn	0.06%
Molybdenum as Mo	0.0005%
Total Zinc as Zn	0.05%

Derived from: Sulfur Coated Urea, Diammonium Phosphate, Activated Sewage Sludge, Triplesuper Phosphate, Muriate of Potash, Suphate of Potash Magnesia, Sodium Borate, Copper Oxide, Iron Oxide, Manganese Oxide, Sodium Molybdate, Zinc Oxide.

*Contains 3.00 units of Slow Release Nitrogen

CAUTION: KEEP OUT OF REACH OF CHILDREN

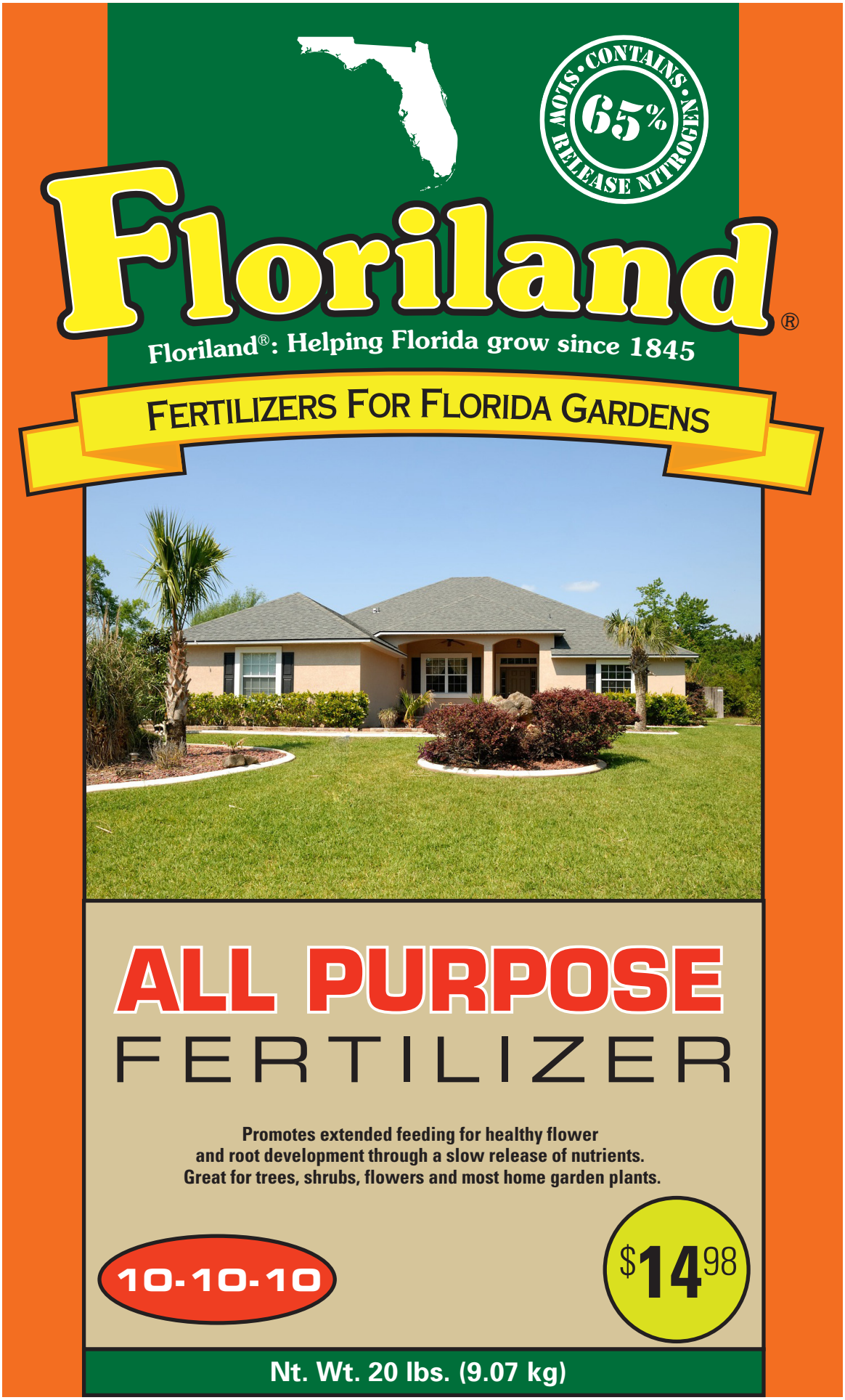
Nt. Wt. 20 lbs. (9.07 kg)

0 33709 33547 0

6-4-6

Manufactured by
FLORILAND CORPORATION
P.O. BOX 01845
Lithia, Florida 33547

FRONT


65% CONTAINS SLOW RELEASE NITROGEN
Floriland®
Floriland®: Helping Florida grow since 1845
FERTILIZERS FOR FLORIDA GARDENS
ALL PURPOSE
FERTILIZER
Promotes extended feeding for healthy flower
and root development through a slow release of nutrients.
Great for trees, shrubs, flowers and most home garden plants.
10-10-10
$14.98
Nt. Wt. 20 lbs. (9.07 kg)

BACK

CONTAINS 65% SLOW RELEASE NITROGEN

Floriland®

Floriland®: Helping Florida grow since 1845

FERTILIZERS FOR FLORIDA GARDENS

ALL PURPOSE FERTILIZER

One simple application provides extended feeding for your plants.

DIRECTIONS FOR USE:

AMOUNT TO USE:

Shrubs and ornamentals: Apply 1.5 cups (12 oz) of fertilizer for every 100 sq ft of planted area. Spread the fertilizer on the soil surface, avoiding the plants' leaves and water in lightly.

Trees: Apply 1 cup (8 oz) of fertilizer for every 2ft of tree height to the base of the tree. Water in lightly.

Flowers, vegetables and home gardens: Apply 1.5 cups (12 oz) of fertilizer every 30 days to the base of the plants, avoiding the leaves. Water in lightly.

TIME TO USE: Apply at the beginning of Spring and every 30 days for flower and vegetable gardens or three times a year (Spring, Summer and Fall) for shrubs and ornamentals.

HOW TO USE: Apply the fertilizer granules at the base of the plant(s) using a scoop or cup. Wear gloves when handling. Water in lightly. This fertilizer may stain sidewalks or other porous concrete surfaces. Always sweep concrete surfaces with a broom after application to avoid staining. Avoid applying fertilizers near lakes, streams, rivers or other bodies of water.

GUARANTEED ANALYSIS F-99

Total Nitrogen* (N)	10.00%*
10.00% ..... Ammoniacal Nitrogen	
Available Phosphate (P_2O_5)	10.00%
Soluble Potash (K_2O)	10.00%
Soluble Magnesium as Mg	1.00%
Boron as B	0.02%
Copper as Cu	0.05%
Iron as Fe	2.00%
Manganese as Mn	0.06%
Zinc as Zn	0.05%
Molybdenum as Mo	0.005%

Derived from: Polymer Coated Ammonium Sulphate, Diammonium Phosphate, Muriate of Potash, Iron Oxide, Manganese Oxide, Sodium Borate, Zinc Oxide, Copper Oxide, Sodium Molybdate, Suphate of Potash Magnesia.

*This portion of the Nitrogen contains 6.5 units of Slow Release Nitrogen

Please check local ordinances before fertilizing!

CAUTION: KEEP OUT OF REACH OF CHILDREN

Nt. Wt. 20 lbs. (9.07 kg)

0 33709 33547 0

10-10-10

Manufactured by
FLORILAND CORPORATION
P.O. BOX 01845
Lithia, Florida 33547

Floriland®

Floriland®: Helping Florida grow since 1845

FERTILIZERS FOR FLORIDA GARDENS

LAWN
FERTILIZER

Phosphorus-free lawn fertilizer with 2% Iron for use on all grass types. Helps green quickly and feeds longer.

29-0-5

$34.98

Nt. Wt. 42 lbs. (19.05 kg)

CONTAINS 2% IRON

Floriland®

Floriland®: Helping Florida grow since 1845

FERTILIZERS FOR FLORIDA GARDENS

LAWN FERTILIZER

This fertilizer helps keep your lawn green and growing vigorously.

DIRECTIONS FOR USE:

DIRECTIONS FOR USE: Apply one 42lb bag for every 15,000 sq feet of grass or lawn using a spreader. To ensure complete coverage, apply starting on the outer edges of your lawn, working toward the center, overlapping slightly.

HOW TO APPLY: Use a spreader (either rotary or drop); do not apply by hand.

GUARANTEED ANALYSIS F-525

Total Nitrogen (N) 29.00%
0.87% ..... Ammoniacal Nitrogen
28.13% ..... Urea Nitrogen*
Soluble Potash (K_2O) 5.00%
Iron as Fe.....2.00%

Derived from: Polymer-Coated Urea, Urea, Muriate of Potash and Iron Sucrate.

*14.50% Slow Release Urea Nitrogen from Polymer-Coated Urea.

ANNUAL FERTILIZATION GUIDELINES:

		SPECIES Only apply to actively grown turf. Maximum Pounds per Application			
	Timing of Application	*Bahiagrass*	*Bermuda*	*St. Augustine*	*Zoysia*
North Florida	Spring/Summer	2	2	2	2
	Fall	1	1	1	1
	Max. Annual Pounds	2 – 3	3 – 5	2 – 4	2 – 3
	Timing of Application	*Bahiagrass*	*Bermuda*	*St. Augustine*	*Zoysia*
Central Florida	Spring/Summer	2	2	2	2
	Fall or Winter	1	1	1	1
	Max. Annual Pounds	2 – 4	4 – 6	2 – 5	2 – 4
	Timing of Application	*Bahiagrass*	*Bermuda*	*St. Augustine*	*Zoysia*
South Florida	Spring/Summer	2	2	2	2
	Fall or Winter	1	1	1	1
	Max. Annual Pounds	2 – 4	5 – 7	4 – 6	2½ – 4½

Please check local ordinances before fertilizing!

CAUTION: KEEP OUT OF REACH OF CHILDREN

Nt. Wt. 42 lbs. (19.05 kg)

0 33709 33555 5

29-0-5

Manufactured by
FLORILAND CORPORATION
P.O. BOX 01845
Lithia, Florida 33547

FRONT

PET SAFE

Floriland®

Floriland®: Helping Florida grow since 1845

FERTILIZERS FOR FLORIDA GARDENS

ALL NATURAL FERTILIZER

An environmentally friendly slow release fertilizer that won't burn plants or harm pets. Includes iron for lawns and turf.

6-4-0

$37.98

Nt. Wt. 30 lbs. (13.61 kg)

PET SAFE

Floriland®

Floriland®: Helping Florida grow since 1845

FERTILIZERS FOR FLORIDA GARDENS

ALL NATURAL FERTILIZER

This fertilizer is great for all household uses: vegetables, herbs, lawns, trees and flowers.

DIRECTIONS FOR USE:

DIRECTIONS FOR USE:

Shrubs- Apply 5 – 6 cups (8 oz) per 75 sq ft of shrub canopy to the base of the shrub. Water in lightly. Apply every 60 days.

Lawns- Apply 80lbs per 2,500 sq ft, twice a year during the growing season using a broadcast rotary or drop spreader. Do not apply fertilizers in North Florida during the winter months or when grass is dormant.

Vegetables- Apply 10 (8 oz) cups for every 10ft of garden space to the soil surface. If applying before planting, mix the fertilizer into the soil. Apply fertilizer 30 days prior to harvest. Water in lightly.

HOW TO USE: Apply the fertilizer granules to the soil below the base of a tree, shrub or plant. If applying to grass, use a spreader to broadcast the fertilizer on the surface. Always wear gloves when handling fertilizers. Avoid applying near bodies of water such as lakes, rivers or streams.

GUARANTEED ANALYSIS **F-99**

Total Nitrogen (N)	6.00%*
2.00% ..... Water Soluble Nitrogen	
4.00% ..... Water Unsoluble Nitrogen	
Soluble Phosphate (P_2O_5)	4.00%
Iron as Fe	2.00%
Calcium as Ca	2.10%

Derived from: Biosolids

*4.00% Slow available Nitrogen derived from Biosolids.

NON-BURNING • PLANT SAFE

Please check local ordinances before fertilizing!

CAUTION: KEEP OUT OF REACH OF CHILDREN

Nt. Wt. 30 lbs. (13.61 kg)

0 33709 33444 2

6-4-0

Manufactured by
FLORILAND CORPORATION
P.O. BOX 01845
Lithia, Florida 33547

Student Activity

Activity 8:
Fertilizer Comparison Shopping *(continued)*

Evaluation Options:

1. Quantitative evaluation may be by a quiz on the characteristics of a fertilizer.

2. Qualitative evaluation may be of the students' active participation in the activity.

3. Mastery evaluation for completion of the activity to include identification of the benefits of biosolids-based fertilizers as compared to chemical ones.

Florida Standards:
SS.8.E.1, SS.912.E.1, MAFS.8.EE.2, MAFS.8.SP.1, MAFS.912.N-Q.1, MAFS.912.S-ID.1, MAFS.912.S-ID.3, MAFS.912.S-IC.2, MA.8.DP1, MA.912.DP.1, MA.912.DP.3, MA.912.DP.5, SC.68.CS-PC.3, SC.68.CS-CS.1, SC.68.CS-CS.2, SC.68.CS-CP.3, SC.912.CS-PC.3, SC.912.CS.CC.1, SC.912.CS-CS.1, SC.912.CS-CS.2, SC.912.CS-CS.3, SC.8.L.18, SC.8.N.1, SC.8.N.4, SC.912.L.17, SC.912.L.18, SC.912.P.8, SC.912.E.6, SC.912.E.7, SC.912.N.1, SC.912.N.3

Notes

Notes

Student Activity

Activity 9:
Designer Trucks

Subject Areas:
Architecture and Construction; Social Studies; Environmental Science; Government and Public Affairs; and Visual Arts.

Behavioral Objectives:

1) The students will construct a model truck used in the biosolids industry.

2) The students will demonstrate the psychomotor skills needed to create a biosolids truck.

3) The students will research information about the types of trucks used in the biosolids industry.

Activity:
Inform the students that they will be researching the types of trucks used in the biosolids industry. Briefly explain what biosolids are and how they are recycled. Tell the students that tank trucks, dump trucks, container trucks, spreader trucks, flat bed trucks, and other types of trucks are all used for the transport and land application of biosolids. Using the templates in this activity, ask the students to choose one of the five trucks to research. The students should be researching how the truck is used by the biosolids industry as well as some interesting facts. The facts can range from the weight of the vehicle, the type of driver's license required to operate a similar truck, the cost of the truck, and/or the unique features of the truck.

After choosing and researching a truck, tell the students they are to construct a model of the truck. It is up to the teacher's discretion what types of media the students are to use to create their trucks (wood, putty, paper, plastic, metal, etc.). Students may also utilize the paper templates included on the following pages to construct "pop-up" trucks. To complete these templates, the students will need glue, scissors

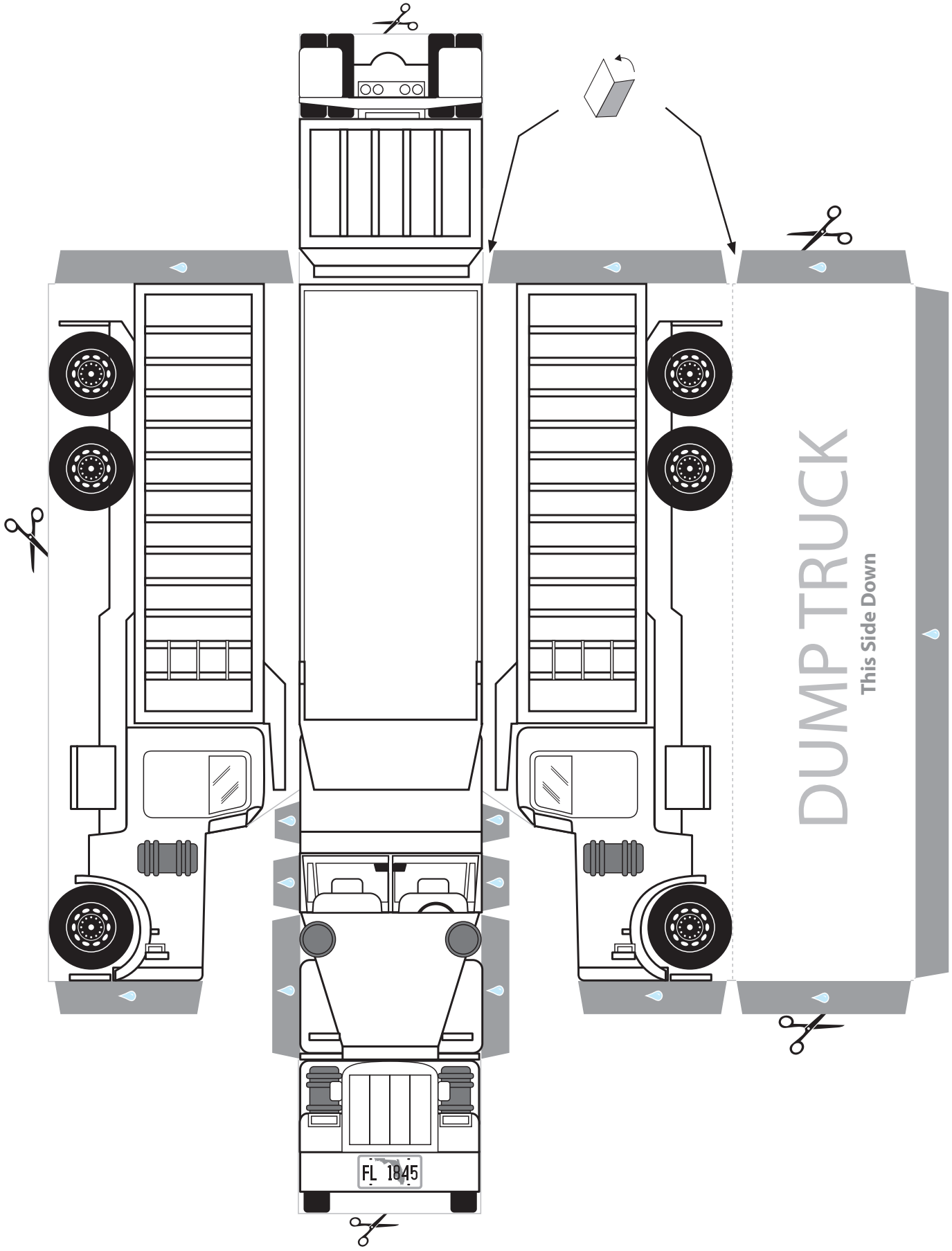
Student Activity

Activity 9:
Designer Trucks *(continued)*

and coloring utensils (optional). Alternatively, the students may construct their trucks out of wood, putty, cardboard, metal or perhaps 3D print one. The students may even choose an artistic rendition such as a drawing or painting, created using computer graphics software.

The students should not only understand the usage of the truck but also its societal impact. These trucks are not only what the public sees but what they perceive as the industry. The trucks and their drivers are important for biosolids important public relations.

Student Handout



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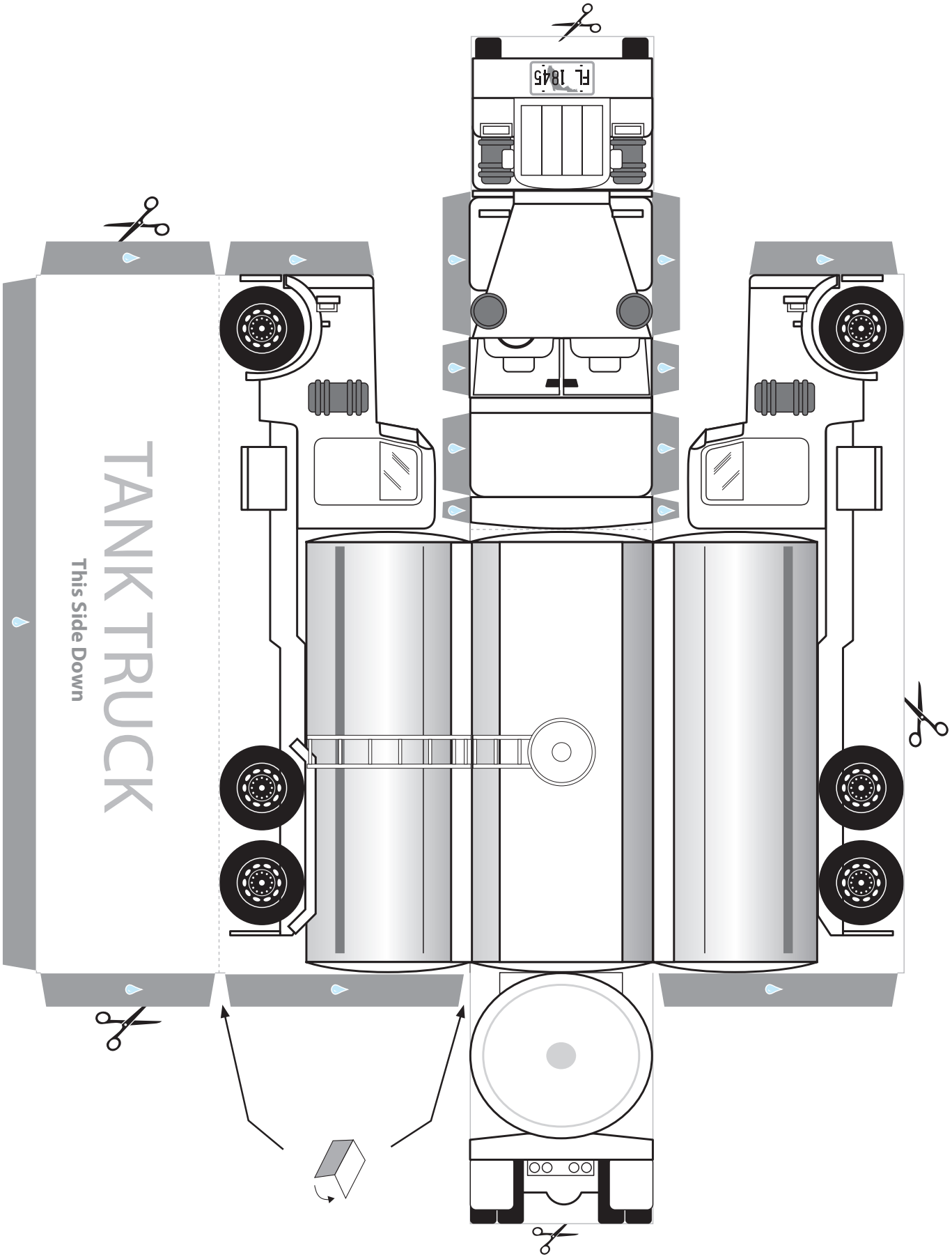
Student Handout



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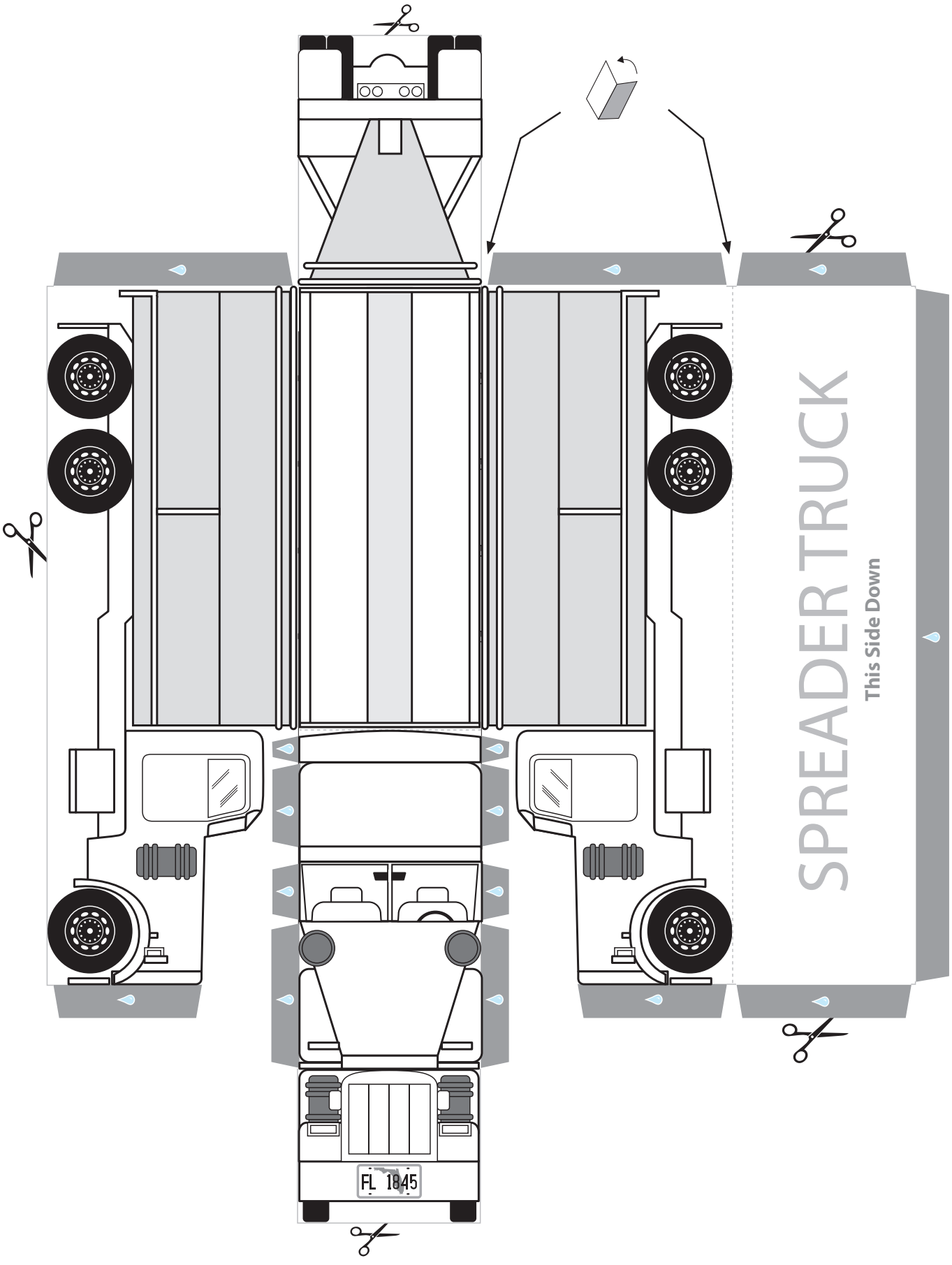

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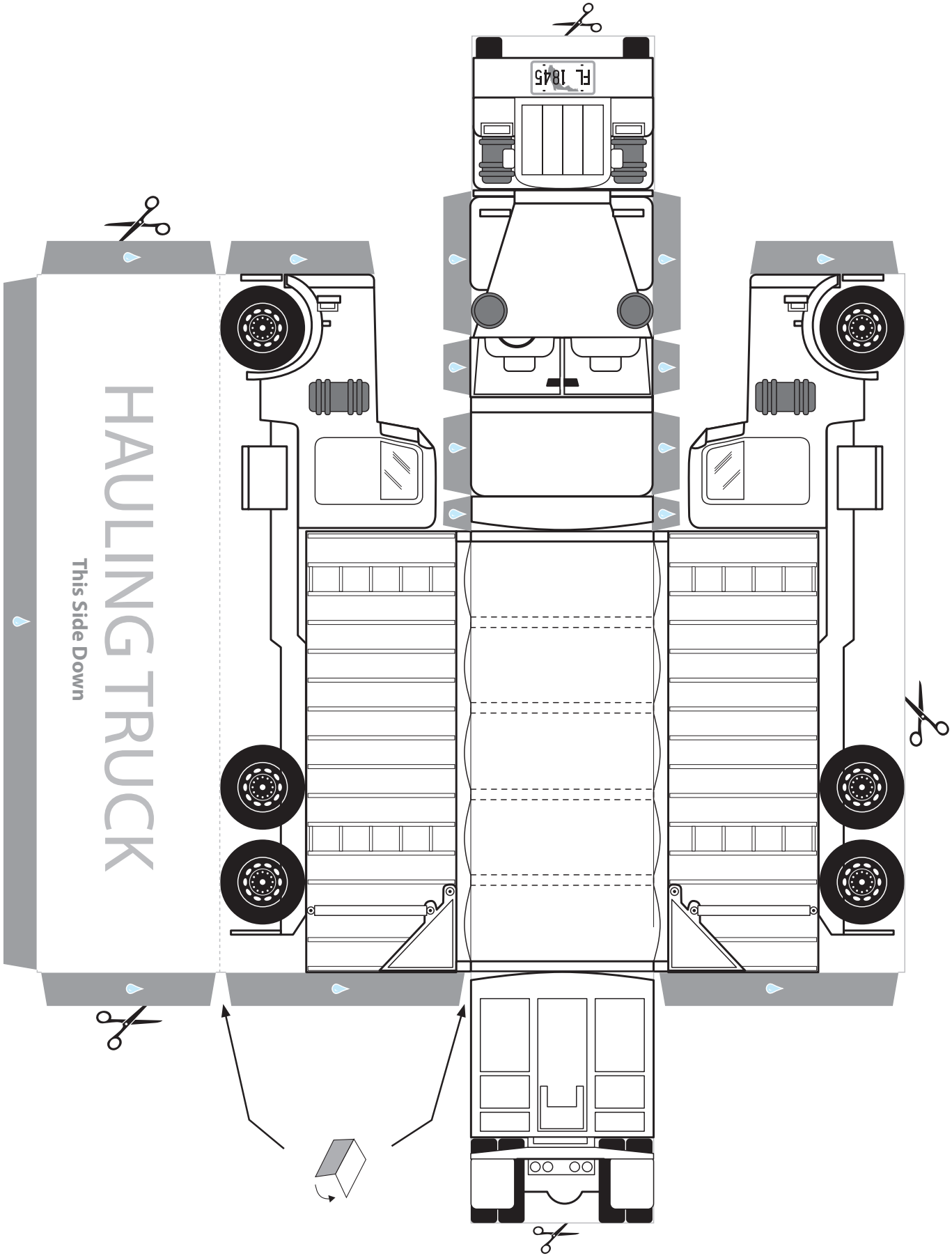

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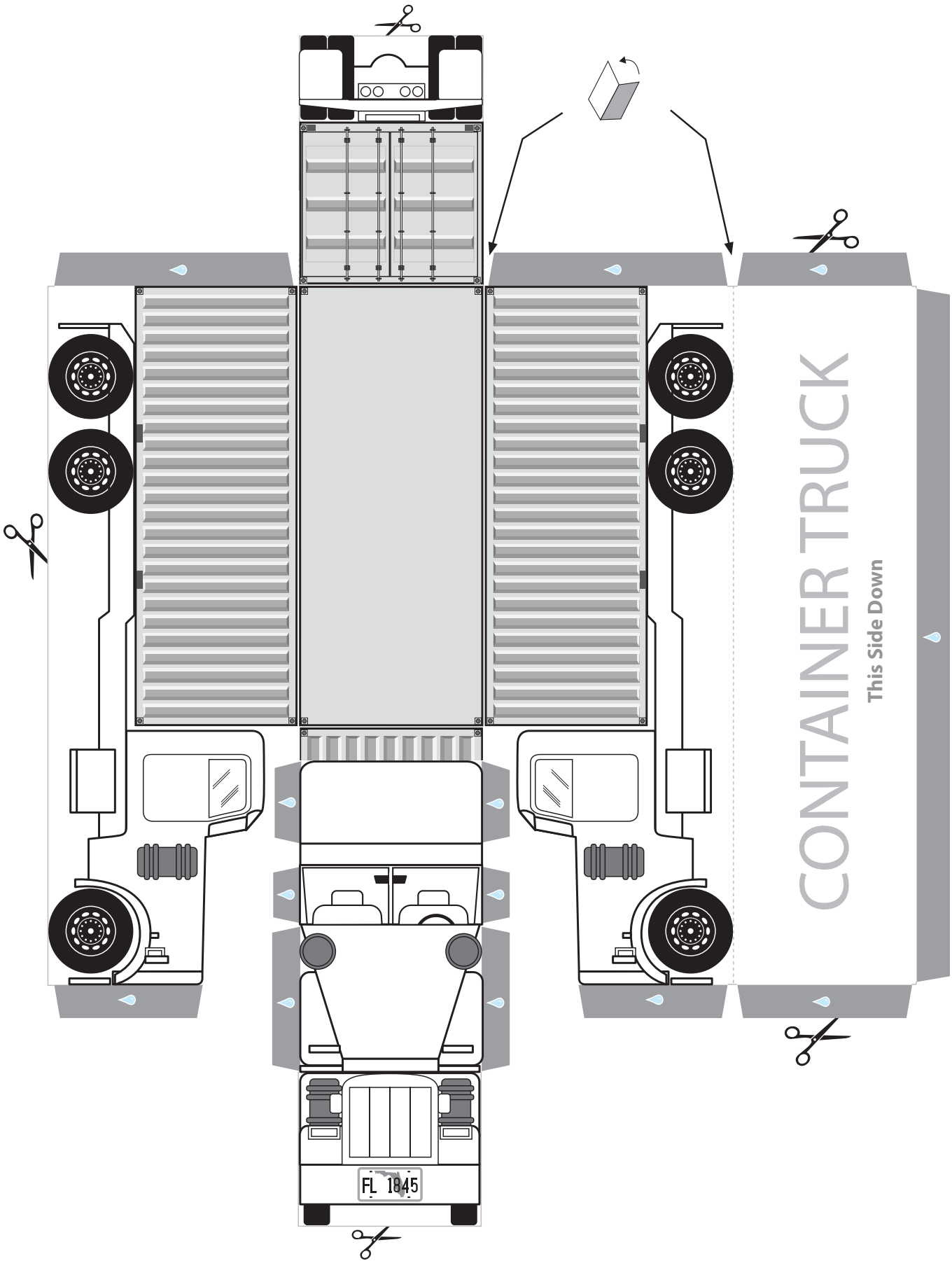

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Student Activity

Activity 9:
Designer Trucks *(continued)*

Evaluation Options:

1. Quantitative evaluation by a quiz on the types and uses of trucks in the biosolids industry.

2. Qualitative evaluation may be a team of teacher judges grading each of the trucks.

3. Mastery evaluation would be attained when each student successfully constructs or creates a biosolids truck.

Florida Standards:
CTE-AC.68.CONSTR.03, CTE-AC.68.CONSTR.04, CTE-AC.68.DESIGN.03, CTE-TECED.68.CONTEC.03, CTE-TECED.68.CONTEC.06, CTE-TECED.68.CONTEC.07, CTE-TECED.68.ENGTEC.07, CTE-TECED.68.ENTECH.08, CTE-TECED.68.NETECH.10, CTE-TECED.68.LSCTEC.02, CTE-TECED.68.TSPTEC.01, CTE-TECED.68.TSPMAR.02, SS.8.E.1., SS.8.E.2, SS.912.E.1, SS.912.E.2, VA.68.C.1, VA.68.O.2, VA.68.H.3, VA.912.C.1, VA.912.O.2, VA.912.H.3, MU.68.C.1, MU.68.O.2, MU.68.H.3, MU.912.C.1, MU.912.O.2, MU.912.H.3, SS.912.H.3, SC.8.N.4, SC.8.N.4

Notes

Student Activity

Activity 10:
Design a Company Logo

Subject Areas:
English Language Arts; Visual Arts; Hospitality and Tourism; Marketing, Sales, and Service; Graphic Arts; and Environmental Science.

Behavioral Objectives:

1) The students will design a logo and choose colors for their truck that are considered publicly acceptable.

2) The students will research biosolids companies' logos to compare their approaches to public acceptance.

3) The students will conduct a presentation of their logo to the class for feedback.

Activity:
Begin the class by presenting the students with a scenario (this scenario is based on a true story and can be easily read out loud to the students): You own a biosolids hauling company that has a large contract with your local county utility. Your company has been tasked with applying treated biosolids to the medians of several major roads and highways throughout the county. Each day, your company drives to a local wastewater treatment facility, picks up the biosolids and then drives to the location where it is then land applied. Your trucks are equipped to do so safely and efficiently. However, your trucks are painted black and have no logos or any other identifying information other than the license plate on them. Recently, calls began pouring into the local police that there were "suspicious black trucks dumping toxic waste on the sides of the roads." As the owner of this company, if your reputation looks bad, you could lose your business with the town, city, or county- over $3 million dollars! You decide that it's time to paint your trucks and create a logo that will raise awareness in your community while keeping the police from calling you every other day!

Student Activity

Activity 10:
Design a Company Logo *(continued)*

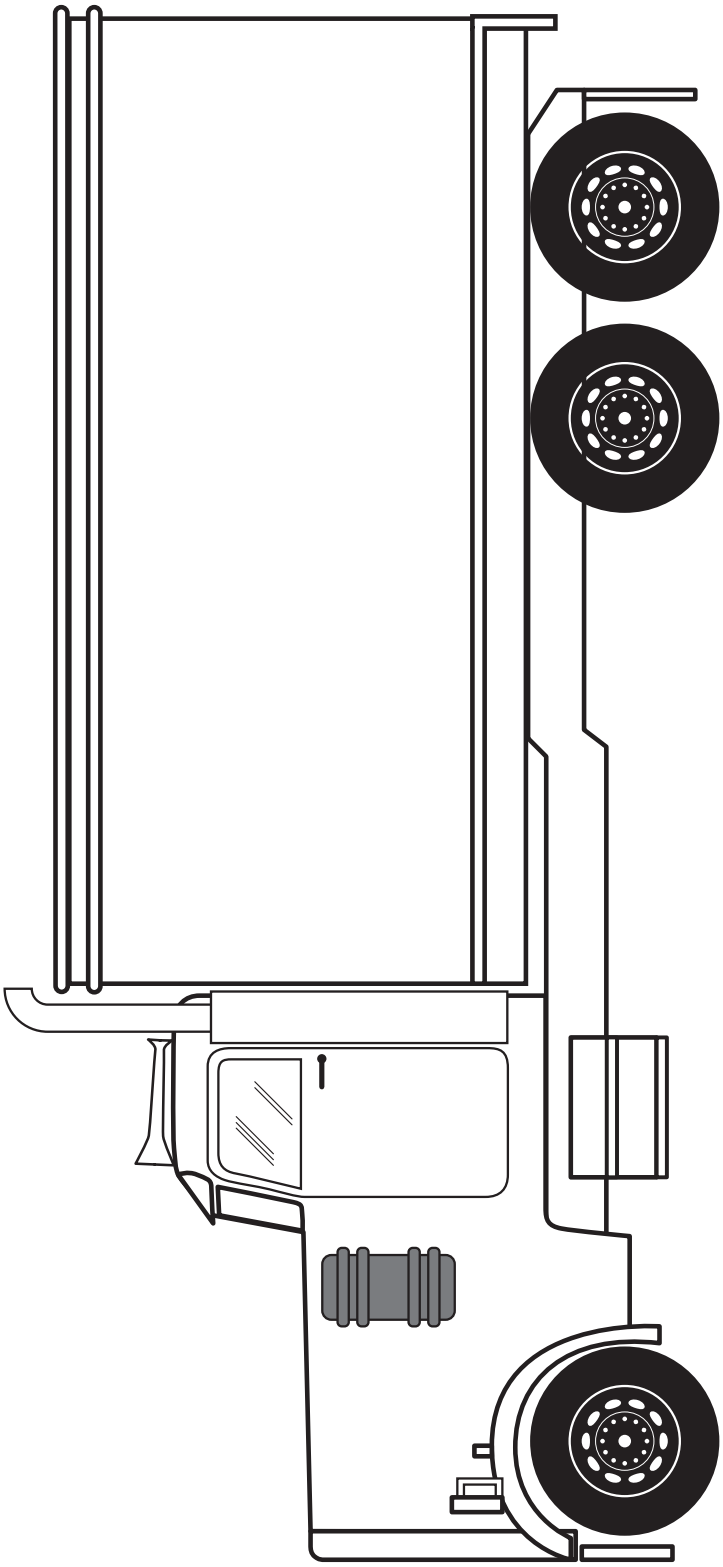
Remind the students to keep a few things in mind when coloring their trucks and designing their logos:

1. Use your logo, a clever slogan, or even a banner the length of the truck to help identify the contents of the truck—remember it's biosolids, not toxic waste!
2. You want to create a positive and publicly acceptable image. This means the general public, not just you or your classmates should like the image. Think about your parents, grandparents, neighbors and even strangers- that's a lot of different types of people!
3. Your design should be informative—don't try to put too much or too little! While writing "Biosolids" on the side of the truck lets people know what the contents of the truck are, most people still don't know what biosolids are.
4. Colored trucks are optional but might help convey to the public a different message- bright colors for instance are often seen as friendly versus black ones.
5. No poo emojis! Remember this is biosolids, not raw human feces! Images like toilets and poo emojis (while funny to some) can be misleading and offensive to others.

On the following page, students can use the outline of a spreader truck to draw, paint, sketch, collage, or glue on their designs as well as color the truck. This image can also be scanned for use in software applications like Adobe InDesign for graphic arts/digital media classes.

Student Handout

Activity 10:
Design a Company Logo *(continued)*



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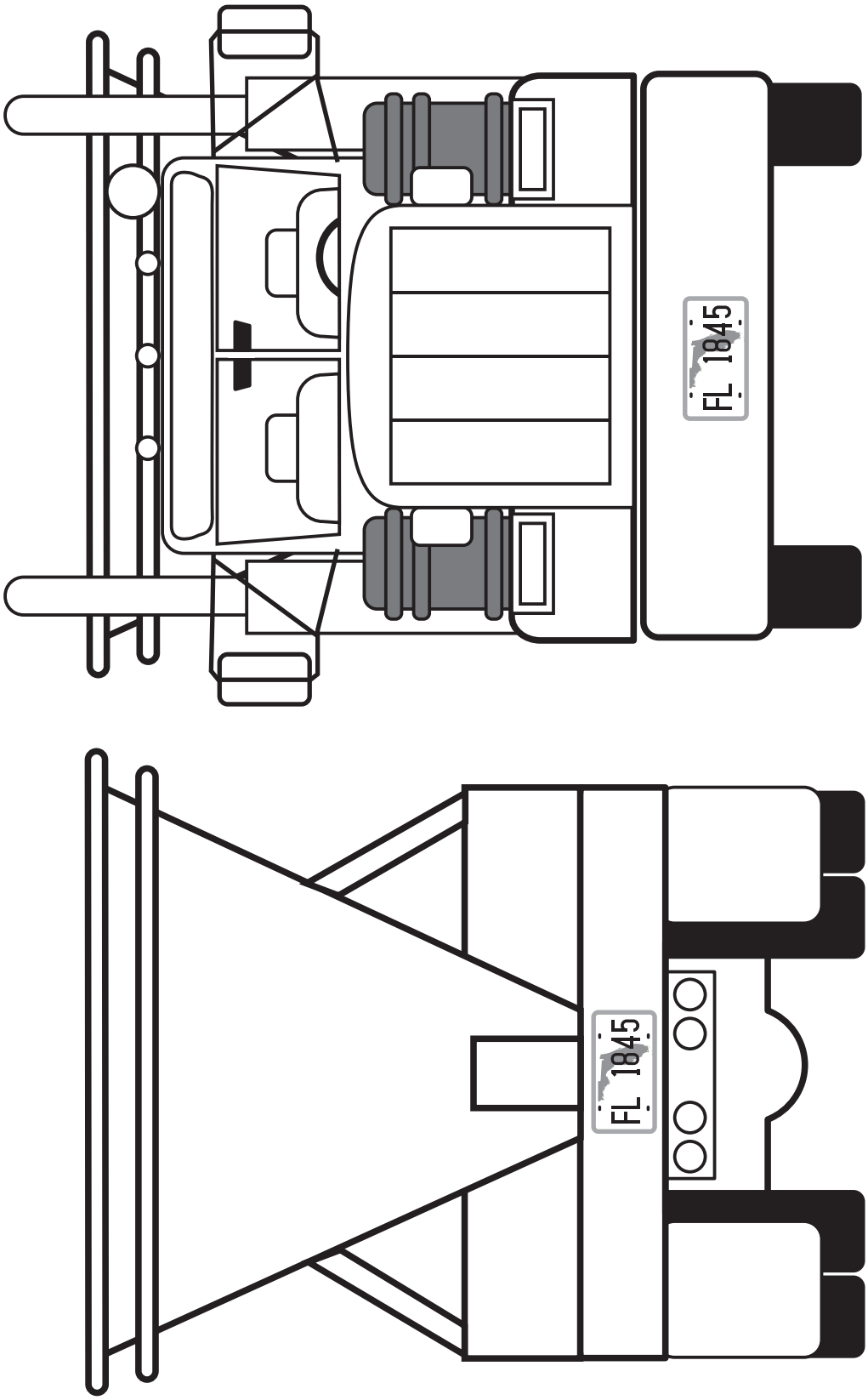

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Student Activity

Activity 10:
Design a Company Logo *(continued)*

Evaluation Options:

1 Qualitative evaluation by observing and recording student individual participation in the activity.
2. Qualitative evaluation may be of the students' active participation in the activity.
3. Mastery evaluation by each student can be done by having students rate each other's designs.

Florida Standards

CTE-AC.68.CONSTR.03, CTE-AC.68.CONSTR.04, CTE-AC.68.DESIGN.03, CTE-TECED.68.CONTEC.03, CTE-TECED.68.CONTEC.06, CTE-TECED.68.CONTEC.07, CTE-TECED.68.ENGTEC.07, CTE-TECED.68.ENTECH.08, CTE-TECED.68.NETECH.10, CTE-TECED.68.LSCTEC.02, CTE-TECED.68.TSPTEC.01, CTE-TECED.68.TSPMAR.02, SS.8.E.1, SS.8.E.2, SS.912.E.1, SS.912.E.2, VA.68.C.1, VA.68.O.2, VA.68.H.3, VA.912.C.1, VA.912.O.2, VA.912.H.3, MU.68.C.1, MU.68.O.2, MU.68.H.3, MU.912.C.1, MU.912.O.2, MU.912.H.3, SS.912.H.3, SC.8.N.4, SC.8.N.4, LAFS.8.W.1, LAFS.8.W.2, LAFS.8.L.1, LAFS.8.L.2, LAFS.8.L.3, SS.912.H.3, LAFS.910.W.1, LAFS.910.W.2, LAFS.910.L.1, LAFS.910.L.2, LAFS.910.L.3, LAFS.1112.W.1, LAFS.1112.W.2, LAFS.1112.L.1, LAFS.1112.L.2, LAFS.1112.L.3

Notes

Student Activity

Activity 11:
"The Sky's the Limit" for Biosolids

Subject Areas:
Biology; Earth Science; Social Studies; Visual Arts; English Language Arts; Speech; and Environmental Science.

Behavioral Objectives:

1) The students will create a presentation for an industry workshop.

2) The students will practice their oral and/or visual presentation skills.

3) The students will conduct a presentation of their new company's approach to biosolids management.

Activity:
Explain to the students that one of the perks of working in the environmental sciences is that employees get to attend professional workshops and conferences. These events are intended to strengthen employees' knowledge (such as learning about new trends in their field or sharing their expertise via presentations), networking, and/or visiting booths to learn about new technologies and products. Inform the students that they will be attending a wastewater-related workshop that involves a lot of biosolids industry professionals like Engineers, Wastewater Facility Managers, Utility Directors, local and state government officials as well as a number of other professionally-minded individuals.

Student Activity

Activity 11: *"The Sky's the Limit" for Biosolids* *(continued)*

Inform the students that they will be attending this workshop as a representative of a brand new biosolids handling company (one that processes biosolids into Class AA fertilizer pellets). Tell the students that the company they are representing (have them choose a name) is a small company with less than 5,000 employees in Florida that needs to sell its business so it can continue to grow across the state! Have the students work in groups to complete two tasks: 1) setting a booth in the exhibitor hall to introduce their company's services to the other workshop attendees (as well as competitors!) and 2) make a 5-10 minute presentation in front of a live audience (i.e. workshop attendees or the class). The presentation can be a traditional one (i.e. PowerPoint) or prerecorded video. The goal of the presentation is to introduce to the attendees why this new company is special (and worthy of their money)! To do this, the students will need to research what are Class AA biosolid fertilizers and how they are made. Guide the students towards the realization that to make biosolids, you must treat wastewater and there are issues every treatment facility must face like:

- Energy costs. Running a wastewater treatment facility takes a lot of energy.
- Odors. Wastewater treatment can be smelly because they deal with raw wastes.
- Operating costs. Equipment, employees, repairs, chemicals…these facilities are expensive.
- Negative public perception. The thought of human waste is gross to most people.

Student Activity

Activity 11:
"The Sky's the Limit" for Biosolids *(continued)*

Have the students choose one of the four above issues and decide what their company would do if it could do anything to help mediate that issue. For instance, the students might propose creating a company that recovers gas from the treatment process —refer to Table 2 (PSRPs) in the introduction section— and uses it as energy internally to drive costs down. In other words, the sky is the limit! Other possibilities may include a new technology to reduce or eliminate odors or a new fleet of trucks with bright colors and smiling logos to increase public perception in a more positive direction. Let the student's imaginations into the realm of science fiction or fact. The intent is to get students to think and create.

Have the students take turns making their presentations. Remind the students that this is a professional setting, so they must dress and act appropriately. Most company representatives will wear slacks and a polo shirt or nice dress shirt. It is usually business casual attire. After each group (or new company) had made their presentation, have the rest of the class decide if they would buy that company's services or not.

Student Activity

Activity 11:
"The Sky's the Limit" for Biosolids *(continued)*

For the booth, you can have students create visuals. A simple booth would consist of a table top display (like a trifold science fair board), a posterboard, a laptop playing a video or commercial, a book of photos, artwork, dioramas, products (real or fake), or any other marketing techniques they can imagine and devise to present their company's services for sale. The students will develop their company's biosolids process or use and try to "sell" it to the other attendees. The workshop could even be a school event. Allow the students time to "walk the exhibit hall" and visit each others' booths and/or displays. Remind the students that their employer is paying them to attend, so they can't just stand at one booth and chat with their friends- they are there to network! One way to keep students moving is have them exchange fake business cards or take notes based on what each booth was offering.

Even though there aren't any real seminars taking place, students will get to experience the commercial environment at a workshop. The students' imaginative efforts will be on display and open to the peer evaluation. The students will also gain exposure to the competitive business of biosolids.

Student Activity

Activity 11:
"The Sky's the Limit" for Biosolids *(continued)*

Evaluation Options:

1 Quantitative evaluation may be conducted by grading the booth presentations.

2. Qualitative evaluation may be a presentation peer-reviewed by the workshop attendees.

3. Mastery evaluation would be by students successfully inventing a new biosolids process or use and creating a presentation and/or booth display that they staff at the workshop.

Florida Standards

CTE.TECED.68.AGBIO.02, SS.8.L.18, SC.8.N.1, SC.8.N.4, SC.912.L.17, SC.912.E.7, SC.912.N.1, CTE-TECED.68.05, CTE-TECED.68.06, SC.912.E.6.6, SC.912.N.4, SC.68.CS-PC.2, SC.68.CS-CC.1, SC.912.CS-PC.2, SC.912.CS-PC.3, SC.912.CS-PC.4, SC.912.CS-CC.1, SS.8.E.1, SS.8.E.2, SS.912.E.1, SS.912.E.2, SS.8.C.1, SS.912.C.2, SS.912.C.3, VA.68.C.1, VA.68.C.2, VA.68.S.1, VA.68.S.2, VA.68.O.2, VA.68.H.3, VA.68.F.1, VA.912.C.1, VA.912.C.2, VA.912.S.1, VA.912.S.2, VA.912.O.2, VA.912.H.3, VA.912.F.3, CTE-TECED.68.ENGTEC.04, CTE.TECED.68.ENGTEC.07, MU.68.C.1, MU.68.C.2, MU.68.S.1, MU.68.S.2, MU.68.O.1, MU.68.O.2, MU.68.O.3, MU.68.H.3, MU.68.F.3, MU.912.C.1, MU.912.C.2, MU.912.S.1, MU.912.S.2, MU.912.O.1, MU.912.O.2, MU.912.O.3, MU.912.H.3, MU.912.F.3

Notes

Student Activity

Activity 12:
Loading Up

Subject Areas:
Mathematics; Environmental Science; Biology; Earth Science; and Food, Agriculture and Natural Resources.

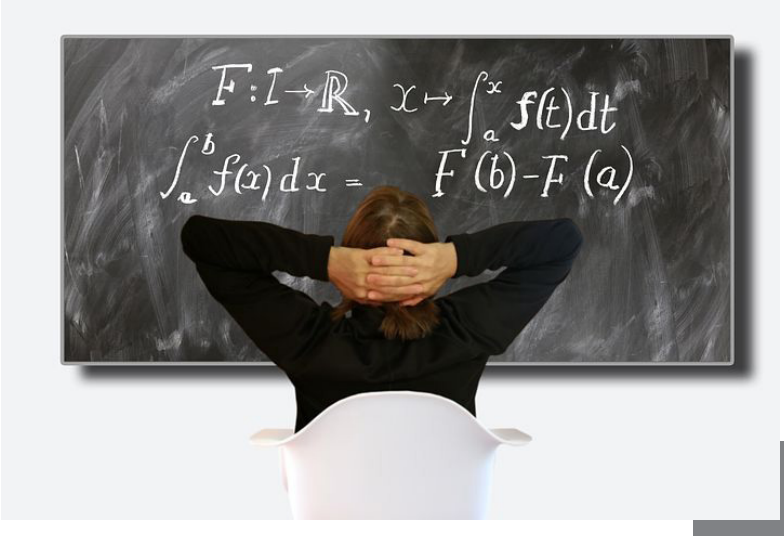
Behavioral Objectives:

1) Students will calculate the nitrogen loading rates and how many acres are needed for land application on a biosolids land application site.

2) Students will distinguish the nitrogen needs of different crops used at a land application site.

3) Students will create a biosolids land application site nitrogen loading spreadsheet.

Begin by explaining to students that although the scientific community uses the metric system, that is not the case here. English equivalents are still used and sometimes, as in biosolids, combined with metrics.



Student Activity

Activity 12:
Loading Up *(continued)*

The students are going to conduct biosolids calculations associated with a land application site. They will use the following equations:

Application Rate:

$$\frac{\text{Gallons of Biosolids}}{\text{Day}} \times \frac{\text{8.34 lbs.}}{\text{Gallon}} \times \frac{\text{365 Days}}{\text{Year}} = \frac{\text{Wet lbs. Biosolids}}{\text{Year}}$$

$$\frac{\text{Wet lbs. Biosolids}}{\text{Year}} \times \text{\% Solids} = \frac{\text{Dry lbs. Biosolids}}{\text{Year}}$$

Nitrogen Loading:

$$\frac{\text{Dry lbs. Biosolids}}{\text{Year}} \times \text{\% Nitrogen} = \frac{\text{lbs. Nitrogen}}{\text{Year}}$$

$$\frac{\text{Wet lbs. Biosolids}}{\text{Year}} \div \frac{\text{Allowable lbs. Nitrogen/Acre}}{\text{Year}} = \text{Acres Required}$$

Example:

2% = 2 ÷ 100 = 0.02

Note:

x (the value for % solids or Nitrogen) = 0.0x or x (divided by 100)

12% = 12 ÷ 100 = 0.12

Student Activity

Activity 12:
Loading Up *(continued)*

The teacher or the students may contact local domestic wastewater treatment facilities for appropriate biosolids characteristics. The biosolids percent nitrogen, amount in gallons of generated biosolids for the last year, and the percent solids of their biosolids will be needed. The numerical nitrogen needs of the different crops may be found in Florida Administrative Code 62-640 or the values may be obtained for different crops from the Institute of Food and Agricultural Sciences at the University of Florida. Have the students then use either teacher or student specified crops with their associated nitrogen needs and the domestic facility nitrogen values, biosolids generated gallons, and percent solids to calculate how many acres would be needed for the facility to land apply their biosolids as a soil amendment based on the crop grown on the field. The students may use different crops on different fields and generate a spreadsheet depicting the crops, acreage, and pounds of nitrogen per acre per year on the field. The majority of biosolids are liquid with percent solids about 1 or 2 percent. Cake biosolids would typically have percent solids of at least 12%.

Example:
Kane Ranch Biosolids Site
Field 1
Bahia grass (improved perennial grass)
allowable nitrogen = 200 lbs/yr
Field 2
Forage legumes allowable nitrogen = 100lbs/yr
Field 3
hay or silage (4 harvests) allowable nitrogen = 400lbs/yr
Field 4
St. Augustine grass (improved perennial grass)
allowable nitrogen = 200lbs/yr
Field 5
Bahia grass (improved perennial grass)
allowable nitrogen = 200lbs/yr

Student Activity

Activity 12:
Loading Up *(continued)*

Phil Wastewater Treatment Facility 2020 Biosolids Characteristics:

Liquid biosolids with four biosolids analyses per year
% nitrogen = 5.5, 4.0, 6.1, 5.8
% solids = 1.2, 1.5, 0.9, 2.1
biosolids gallons generated = 280,000 gallons/year

The students would then calculate how many acres would be needed in each field for biosolids land application. As a math teacher the nitrogen loading relationships and calculations could easily be adapted to your class needs. The calculations may be approached from whatever direction the teacher deems relevant to the class.

Standard Fertilization Recommendations for Agronomic Crops in Florida

Crop	N (lbs/A)
Corn, irrigated	210
Oats or Rye for Grain or Sileage	70
Cotton	60
Peanuts	0
Soybeans	0
Tobacco	80
Sugarcane	90
Grain Sorghum	150
Warm Season Legumes	0
Cool Season Legumes	0
Alfalfa	0
Perennial Grasses	160
Wheat for Grain	80

Where nitrogen is given in pounds (lbs) per acre (A)

Adapted from UF IFAS Standardized Fertilizer Recommendations for Agronomic Crops by R, Mylavarapu, D. Wright, and G. Kidder (2020).

Student Activity

Activity 12:
Loading Up *(continued)*

Evaluation Options:

1. Quantitative evaluation could be quiz.

2. Qualitative evaluations by observing student development of the land application spreadsheet.

3. Mastery evaluation by students completing successfully the land application spreadsheet calculations.

Florida Standards:
CTE-AFNR.68.AGBUS.03, CTE.AFNR.68.GENRL.03, CTE.AFNR.68.GENRL.04, CTE.AFNR.68.GENRL.08, CTE.AFNR.68.PLANT.05, MAFS.912.A-CED.1, MAFS.912.G-GMD.2, MAFS.912.G-MG.1, MMA.912.GR.4, MA.912.F.1, CTE-AFNR.68.ENVIRO.02, CTE-AFNR.68.ENVIRO.03, CTE-AFNR.68.ENVIRO.04, SC.8.L.18, SC.8.N.1, SC.8.N.4, SC.68.CS-CC.1, SC.68.CS-CS.1, SC.68.CS-CS.2, SC.912.L.14, SC.912.L.17, SC.912.L.18, SC.912.P.8, SC.912.N.1, SC.912.N.4, SC.912.CS-PC.2, SC.912.CS-CC.1, SC.912.CS-CS.1

Notes

Student Activity

Activity 13:
A Residuals Sense of Humor

Subject Areas:
English Language Arts; Social Studies; Visual Arts; Biology; Environmental Science; Music; Theatre; and Food, Agriculture and Natural Resources.

Behavioral Objectives:

1) The students will identify components of biosolids issues that can be presented in a humorous way.

2) The students will demonstrate the creative process in order to create a humorous result.

3) The students will create a residuals humor product.

Activity:
Explain to the students what residuals are and how they are used. Present the students with a discussion stating that biosolids issues can be emotionally charged issues. Inform the students that people's reactions range from immediate disgust, fear, and repulsion to wholehearted embrace of the idea of recycling biosolids. The task of the students will then be to identify those aspects of residuals issues that may be translated into some kind of humor.

Student Activity

Activity 13:
A Residuals Sense of Humor *(continued)*

It should most emphatically be stated that under no circumstances is the humor to be blatantly offensive to others. For perspective, the humor should be that which the students could show to the parents and grandparents of their friends!

With that in mind, some examples of humor are outhouse models or paintings, memes, animations, cartoons depicting some residuals aspect, a joke, a song, a short story, or a toilet sculpture would be appropriate. In some way the residuals humor should demonstrate biosolids views with a sense of humor. One example is the joke, "why did the chicken cross the road?—to get to the biosolids fertilized grass." Another example would be a cow cartoon where the cow is posting a sign next to a town. The sign states that no people are allowed for thirty days after the last application of manure. Humorous creative thought interpreting biosolids issues is the goal. After the students have completed the activity the humor may be shown to the class or even the entire school.

Student Activity

Activity 13:
A Residuals Sense of Humor *(continued)*

Evaluation Options:

1. Quantitative grading of the residuals humor products.

2. Qualitative evaluation could be observation and notes on the creative process.

3. Mastery evaluation would be completed by the successful creation of a residuals humor product.

FCAT Standards:

LAFS.8.W.1, LAFS.8.W.2, LAFS.8.W.3, LAFS.8.L.2, LAFS.8.L.3, LAFS.910.W.1, LAFS.910.W.2, LAFS.910.W.3, LAFS.910.L.1, LAFS.910.L.2, LAFS.910.L.3, LAFS.910. WHST.2, LAFS.910.WHST.3, LAFS.1112.W.1, LAFS.1112.W.2, LAFS.1112.W.3, LAFS.1112.L.1, LAFS.1112.L.2, LAFS.1112.L.3, LAFS.1112.WHST.1, LAFS.1112.WHST.2, LAFS.1112.WHST.3, ELA.8.C.1, ELA.8.C.5, ELA.8.V.1, ELA.9.C.1, ELA.9.C.3, ELA.9.C.4, ELA.9.C.5, ELA.9.V.1, ELA.10.C.1, ELA.10.C.3, ELA.10.C.5, ELA.10.V.1, ELA.11.C.1, ELA.11.C.3, ELA.11.C.5, ELA.11.V.1, ELA.12.C.1, ELA.12.C.3, ELA.12.C.5, ELA.12.V.1, VA.68.C.1, VA.68.S.1, VA.68.S.2, VA.68.O.2, VA.68.O.3, VA.68.H.3, VA.68.F.1, VA.912.C.1, VA.912.S.1, VA.912.S.2, VA.912.O.2, VA.912.O.3, VA.912.H.3, VA.912.F.1, SS.8.E.1, SS.8.C.1, SS.8.C.2, SS.912.E.1, SS.912.C.2, SS.912.C.3, SS.912.S.7, SS.912.S.8, MU.68.C.1, MU.68.O.3, MU.68.H.3, MU.68.F.3, MU.68.C.1, MU.912.O.3, MU.912.H.3, MU.912.F.3, CTE-TECED.68.CONTEC.01, CTE-TECED.68.AGBIO.01, SC.8.L.18, SC.8.N.4, SC.8.CS-CC.1, SC.912.L.14, SC.912.L.18, SC.912.N.4, SC.912.CS-PC.1, SC.912.CS-CC.1

Notes

Student Activity

Activity 14:
Emerging Contaminants

Subject Areas:
English Language Arts; Social Sciences; Science; Family and Consumer Sciences; Environmental Science; and Food, Agriculture and Natural Resources.

Behavioral Objectives:

1) The students will practice researching, reading and/or using product labels to make more environmentally conscious decisions.

2) The students will examine how the products they use each day can contribute to the growing complexities of treating wastewater.

3) The students will learn to identify emerging contaminants found in the wastewater stream that may be potentially transferred to biosolids.

Activity:
Begin by asking the class a simple but direct question, "Why does science matter?" While the students may be caught off guard by this question, try to steer the students responses towards recognizing the benefits of science on society:

- Knowledge of an issue or subject
- An understanding and appreciation of the natural world
- To remove biases or correct inaccurate information
- To make better decisions about how we live our lives
- To standardize our methodologies (i.e. how we do research)
- To facilitate communications about subject matters
- To encourage human curiosity
- To drive innovation

Student Activity

Activity 14:
Emerging Contaminants *(continued)*

After the students have finished brainstorming why science matters, ask them to define wastewater. Explain to the students that all the used water in a building, wastewater, must somewhere to get treated. To complicate matters, all this water contains chemicals, bacteria (including pathogens), sewage, and trash. This means that all this dirty water must now be treated for all of those things. Have the students begin by creating a list of all the ways they use water in a day. Examples may include bathing, flushing toilets, washing hands, brushing teeth, cooking, cleaning dishes, and laundry, etc. Then ask the students to list in a separate column all the things that might potentially go down the drain or toilet while they do these things. An example table is included in this section. Challenge the students to not jus think of the obvious things like water or soap when you wash your hands but why they are washing their hands to remove things like dirt, bacteria, blood, chemicals, dead or damaged skin, etc.

After the students have completed their tables, explain to them this is a perfect example of why science matters: in order to treat wastewater properly so it does not make humans or the environment sick, you have to know what is in it and how to treat it. This is an everyday challenge in the industry because as science advances, we are discovering "emerging contaminants." This means that seemingly harmless products we use everyday, like exfoliating face washes may contain contaminants like microplastics that are being discovered in wastewater and potentially in the biosolids (i.e. fertilizers).

Student Activity

Activity 14:
Emerging Contaminants *(continued)*

Emerging contaminants is growing field. It constantly evolves and as a result, it helps us to change our habits and the products we use. An example of a positive outcome was in 2015, when the US banned the use of "microbeads" in personal care products like face washes. These seemingly harmless plastic beads were designed to give face washes an exfoliating effect (often described as gritty feeling). However, these small pieces of plastic (5mm or less in size) do not always biodegrade and were being found on beaches and even inside the stomachs of sea life. Unfortunately, plastics are ubiquitous in our everyday lives and can be found in clothing, personal care products, and even in the tires on our cars to name a few. Even with the ban on microbeads, larger pieces of plastics can be broken into smaller pieces and eventually become microplastics, making it a challenge for wastewater treatment facilities.

Student Activity

Activity 14:
Emerging Contaminants *(continued)*

Example table of how I used water today:

Ways I used water today	***Things that might go down a drain in the process and enter the wastewater stream***
Showered before school.	Shampoo, conditioner, liquid or bar soap, face wash, shaving cream, hair (head and from shaving body parts), skin, bodily fluids, toe nails (clipped nails in shower), exfoliating face wash
Brushed and maintained my teeth.	Toothpaste, mouthwash, floss
Washed dishes after cooking bacon and eggs for breakfast.	Dish soap, food crumbs, oil, grease, pieces of the sponge, coffee with some residual grounds.
Flushed toilets (multiple times).	#1, #2, toilet paper, flushable wipes, feminine hygiene products, medicines (metabolized in body and excreted)
Tidied the bathroom at home (chore).	Glass cleaner, shower cleaner, bleach, clothing fibers (from disintegrating rags)
Washed hands after I cut myself on accident at school.	Antibacterial soap, blood, antiseptic wipe (to clean wound), band aid
Drank from water fountain at school.	Water
Showered at school after playing soccer.	Dirt, grass, bar soap, sunscreen, shampoo, conditioner, hair gel, deodorant, medicine (topical antibiotic for rash), hair
Washed dishes in dishwasher at home after having dinner with my family (4 people).	Dishwasher soap (in a gel pack), food particles, liquids from cups (soda, coffee, water)
Bathed baby brother after he went in his diaper.	Baby soap, shampoo, baby powder, baby wipes, puke or saliva.
Washed hands after completing art-related homework assign-ment	Hand soap, glitter, glue, tiny pieces of paper (got stuck to hands from all the glue), paint (washed paintbrush)
Watered and took care of mom's plants on the kitchen window sill.	Water, fertilizer, neem oil (for pests)
Ran a load of laundry (needed more sports uniforms).	Dirt, grass, a small pebble or two, laundry soap, hair, skin, blood (scrapped knee), coffee (stain om shirt from this morning), sweat, fibers from clothing (threads, sequins, rhinestones, glitter, paint)
Helped mom clean the kitchen after dinner.	Vinegar (for cleaning), sanitizing wipes, fibers from rag used to wipe counters

Student Activity

Activity 14:
Emerging Contaminants *(continued)*

After the students complete their tables, explain to them that every product we use has chemicals and that those chemicals (sometimes even plastics) can become dangerous. Why? It often takes years to understand (through observation and data collection) that something is a contaminant or a potentially harmful chemical. Not all contaminants are chemicals, some are biological like viruses or bacteria that have evolved and are resistant to antibiotics. Below is a list of a few major emerging contaminants found in wastewater. While the effects of these contaminants on biosolids is lesser known, scientists and researchers (especially universities) are often on the forefront of these efforts.

Pharmaceuticals and personal care products (PPCP)	***Pesticides and herbicides***
Endocrine disruptors • Illegal drugs • Opioids • Antibiotics • Caffeine and ibuprofen Commonly found in households or where medications or drugs exist.	• Dioxins • Organochlorine • Triazine Can be found in contaminated soils, water, and even food (crops).
Per- and polyfluoroalkyl substances (PFAS)	***Microplastics***
• Perfluorosulfonate acid (PFOS) • GENX • PFAS Commonly found in stain- and water-repellent fabrics, nonstick products (e.g., Teflon), polishes, waxes, paints, cleaning products, and fire-fighting foams.	• polyethylene (PE) • polypropylene (PP) • polyethylene terephthalate (PET) • polymethyl methacrylate (PMMA) • polytetrafluoroethylene (PTFE) • nylon Commonly found in household chemicals, personal care products, tires, and clothing.
Antibiotic Resistance	***Novel Pathogens***
• Bacteria • Genes	• Coronavirus (SARS CoV-2)

Student Activity

Activity 14:
Emerging Contaminants *(continued)*

After explaining to students or presenting them with the above table, assign the students to choose one or multiple household items from their list above that they would like to research the ingredients of. For instance, they might choose shampoo, laundry detergent, tooth paste, herbicide or a container of paint. Using the list above or an internet search, they are looking for possible contaminants in their everyday products. You may also choose to assign products to the students that you find in your classroom or home like dry erase boards, stain retardant table cloths, a rain coat, car tires, non-stick pans, or common herbicides readily available at a home improvement store. While drugs (legal or illegal) are contaminants, we do not recommend assigning them to students for obvious reasons. Have the students compare their findings with one another—they will be surprised at how many products contain emerging contaminants!

Keep in mind the goal of this activity is not to scare students but to raise awareness of the consequences of everyday life. The more chemicals and products we consume, the more waste we generate. These contaminants do not "go away" after they go down the drain. They can potentially contaminate the wastewater stream and the biosolids made from that wastewater! If the biosolids are contaminated, they can harm the environment when they are spread or applied, releasing contaminants into soils, waterbodies, food crops, and possibly the livestock we consume. In other words, we must make better choices and become more informed consumers!

Student Activity

Activity 14:
Emerging Contaminants *(continued)*

Evaluation Options:

1. Quantitative evaluation may be of the students' active participation in the activity.

2. Quantitative evaluation may be by grading the students' list of water-related activities for thoroughness and/or creativity.

3. Mastery evaluation for completion of the activity to include identification of one or more emerging contaminants found in daily products.

Florida Standards:
LAFS.8.RI.1, LAFS.8.RI.2, LAFS.8.RI.3, LAFS.8.W.1, LAFS.8.W.2, LAFS.8.W.3, LAFS.8.SL.1, LAFS.8.SL.2, LAFS.910.RI.1, LAFS.910.RI.2, LAFS.910.RI.3, LAFS.910.W.1, LAFS.910.W.2, LAFS.910.W.3, LAFS.910.SL.1, LAFS.910.SL.2, LAFS.910.RST.2, LAFS.910.RST.3, LAFS.1112.RI.1, LAFS.1112.RI.2, LAFS.1112.RI.3, LAFS.1112.W.1, LAFS.1112.W.2, LAFS.1112.W.3, LAFS.1112.SL.1, LAFS.1112.SL.2, LAFS.1112.RST.2, LAFS.1112.RST.3, ELA.8.R.2, ELA.8.R.3, ELA.8.C.4, ELA.8.V.1, ELA.9.R.2, ELA.9.R.3, ELA.9.C.4, ELA.9.V.1, ELA.10.R.2, ELA.10.R.3, ELA.10.C.4, ELA.10.V.1, ELA.11.R.2, ELA.11.R.3, ELA.11.C.4, ELA.11.V.1, ELA.12.R.2, ELA.12.R.3, ELA.12.C.4, ELA.12.V.1, SS.8.G.2, SS.8.G.3, SS.8.G.4, SS.8.G.5, SS.8.G.6, SS.8.E.1, SS.8.C.1, SS.912.G.2, SS.912.G.3, SS.912.G.4, SS.912.G.5, SS.912.G.6, SS.912.E.1, SS.912.C.2, SS.912.H.3, SC.8.P.8, SC.8.P.9, SC.8.N.1, SC.8.N.4, SC.912.L.17, SC.912.L.18, SC.912.P.8, SC.912.E.6, SC.912.E.7, SC.912.N.4, CTE-AFNR.68.AGBUS.02, CTE-AFNR.68.AGBUS.03

Notes

Resources

South Cross Bayou Education Program Teacher Resources
http://www.pinellascounty.org/utilities/educational/teachers.htm

Florida Water Environment Association
https://www.fwea.org/biosolids_infusion_unit.php

DEP Domestic Wastewater Biosolids
https://floridadep.gov/water/domestic-wastewater/content/domestic-wastewater-biosolids

EPA Biosolids
https://www.epa.gov/biosolids

Discover Magazine: What The Earliest Toilets Say About How Human Civilization Has Evolved
https://www.discovermagazine.com/planet-earth/what-the-earliest-toilets-say-about-how-human-civilization-has-evolved

Glossary

Aeration Tanks- A fluid holding tank used in the wastewater treatment process by which air is added to the liquid. It is a form of biological or secondary treatment.

Aerobic- Requiring free oxygen.

Aggregates- Groups of soil particles that stick together (or bind) stronger than the surrounding soil particles.

Anaerobic Digestors- Tanks used in the wastewater treatment process that use micoorganisms to break down organic materials in the absence of oxygen.

Anoxic Tanks- A fluid holding tank used in the wastewater treatment process where no additional air (or oxygen) is added. It is a form of biological or secondary treatment.

Biosolids- The nutrient-rich organic materials produced by wastewater treatment processes for beneficial recycling. The term 'Biosolids' is replacing the term 'Sludge' in reference to treated wastes.

Cake Biosolids- Once the raw sludge (or feces) is removed from the wastewater stream and treated, the water is removed (called dewatering) to produce a product that is 15-30% solids.

Chlorine- A chemical used to disinfect waters.
It is commonly used in swimming pools as well as at wastewater treatment facilities to kill pathogens or disease-causing microorganisms.

Class AA- The highest regulatory class of biosolids. These biosolids have been treated to eliminate pathogens and contain fewer metals than Class A.

Class A- The intermediate class of biosolids. These biosolids have been treated to eliminate pathogens.

Glossary

Class B- The minimum regulatory class of biosolids. These biosolids have been treated to significantly reduce pathgens.

Decomposers- Organisms responsible for breaking down dead or decaying matter such as animal wastes, fallen leaves, corpses, etc.

Denitrification Filters- An example of an advanced or tertiary treatment process in wastewater treatment. Denitrification filters help to remove nitrates from the wastewater stream.

Effluent- The treated water (i.e. end result of treatment) from a wastewater treatment facility.

Environmental Stewardship- The responsible use and protection of the natural environment via awareness, conservation and sustainable practices.

Eutrophication- The result of excess nutrients (usually nitrogen and/or phosphorus) entering a water body which then causes a dense growth of aquatic plant life. As this plant life dies, it consumes dissolved oxygen, killing marine life.

Fertilizers- A substance of organic (i.e. manure) or chemical origin that improves soil fertility.

Food Web- The natural interconnection between living organisms. Often illustrated graphically as a "who eats who" in an ecological community.

Headworks- A facility in a wastewater treatment facility where trash ad large pieces of debris like flushable wipes, feminine hygiene products, toys, jewelry, hair, clothing and other undesirable items are removed from the wastewater stream.

Humus- The organic component of soil that is formed by the decomposition of plant materials like leaves by microorganisms.

Glossary

Hypoxic- Low or deleted oxygen in a waterbody.

Inorganic- Relating to or derived from a non-living organism.

Leach- When a soluble liquid (or chemical) moves down the soil profile past the depth by which plant roots can uptake it.

Liquid Biosolids- The treated sludge (or feces) from the wastewater stream that contains 94-97% water (or 3-6% solids).

Macronutrient- Nutrients required in larger quantities by plants for essential growth: carbon, oxygen, hydrogen, nitrogen, phosphorus, potassium, magnesium, calcium and sulfur.

Micronutrient- Nutrients required in smaller quantities by plants for essential growth: boron, zinc, manganese, iron, copper, molybdenum, and chlorine. They constitute in total less than 1% of the dry weight of most plants.

Microorganisms- Also called microbes, are microscopic organisms that may exist as single celled forms or colonies of cells.

Municipalities- Often a city or town; it has powers of self governance and corporate status as granted by national and regional state laws.

Nitrate- An inorganic, water-soluble form of nitrogen that can be easily uptaken by a plant. It is a common component of chemical fertilizers.

Nitrogen- A macronutrient required by plants.

N-P-K Value- A three number value (or ratio of N to P to K) of nitrogen, phosphorus, and potassium in a fertilizer product. These three values represent the three largest nutrients used by plants.

Glossary

Nutrient Management Plan- A document used to manage the source, rate, form, timing, placement and utilization of nutrients, including manures and biosolids, in the soil. It is commonly used in Agriculture and Ranching operations.

Ordinances- a piece of legislation enacted by a municipality or local government. Ordinances generally govern matters not covered by state or federal law like noises, pet restrictions, zoning regulations, and building regulations.

Organic- Relating to or derived from a living organism.

Outhouse- Refers to a structure separate from a home or the main building which contains a toilet.

Pathogens- Organisms that cause disease or illness.

Phosphorus- A macronutrient required by plants that is present in all plant cells.

Plant Available- Nutrients that are easily up taken by a plant. Organic nutrients must be converted to plant available forms by other organisms.

Potassium- A macronutrient required by plants.

Primary Treatment- In wastewater treatment, primary processes are designed to remove the settleable organic and inorganic solids as well as floating materials removed by skimming. The density of the solids and floating materials make them separable in the wastewater stream.

Reclaimed Water- Treated water delivered from a wastewater or water reclamation facility to the community for reuse (usually irrigation). It is not drinking water.

Renewable Resource- A natural resource which will be replenished in a finite amount of time to replace the portion depleted by consumption through natural or otherwise recurring processes.

Glossary

Residuals- Another term given to solids recovered from the wastewater treatment process.

Reuse Water- Water that is treated at wastewater facility that is safe and intended for reuse purposes such as irrigation, cooling, aquifer recharge, etc.

Secondary Clarifiers- A wastewater treatment process that allows the solids to separate from the liquid stream.

Secondary Treatment- In wastewater treatment, these processes are designed to remove the soluble organics that weren't captured during primary treatment. Secondary processes involve biology such as microorganisms that consume the organic materials.

Septic Tank- An underground tank made of concrete, fiberglass or plastic designed to treat domestic wastewater. It is considered a primary treatment whereby settling and anaerobic processes reduce solids and organics.

Sewer System- A series of pipes and pumps that transport wastewater from the water user to the wastewater treatment facility for treatment.

Sludge- A term used by wastewater treatment facilities to describe the settleable solids separated from liquids during the treatment process. It is also called 'biosolids.'

Solids- A synonym used by the industry to describe human excrement or feces in wastewater.

Soil Profile- A vertical representation (or a "slice") of soil by depth. As one goes deeper, the soil is divided into sections or horizons. These horizons describe the properties of the soil.

Stakeholders- Anyone involved in the decision making process or the outcome.

Glossary

Stormwater- In Florida, this is water that runs off impervious surfaces like sidewalks into storm drains or waterbodies. It is not treated like wastewater. Typically it is rain water.

Tertiary Treatment- In wastewater treatment, it is the final processes that use advanced techniques to focus on specific pollutant removal.

Treatment Facility- A regulated facility that uses a variety of processes to treat (or make wastewater safe) for reuse or release into the environment.

Vectors- Organisms that my potentially spread disease. Examples include mosquitos, rats, and roaches.

Wastewater- The used water generated by everyday activities such as bathing, washing dishes, laundry, flushing toilets that exits a building to either a septic tank or sewer system.

Water-soluble Components- Substances that are dissolved in water. Some nutrients can be easily dissolved in water (i.e. nitrate) whereas others (i.e. phosphate) are not.

Residuals. Biosolids. Sludge.
What happens after you flush the toilet shouldn't be a subject of taboo. It is a topic that should be infused into every classroom subject ranging from science to social studies to the visual arts and even theatre, as it affects everyone. In Florida, the "wastes" that travel down a toilet and are recovered at a treatment facility are called residuals, biosolids, and/or sludge.

But this isn't a book about waste management. It's a curriculum infusion designed for teachers and informal educators (grades 6+) about recovering renewable resources from wastes while promoting environmental sustainability. It's an educational resource packed with fourteen activities to introduce students to some of the topics and issues faced everyday by the biosolids industry. These topics include public relations, regulatory compliance, wastewater treatment operations, emerging contaminants from household products and so much more!

This is a book about inspiration and how nature inspires each of us every day. Through natural processes, the environment recycles wastes, but we've only begun to understand how to use science to engineer these processes to meet growing populations!
As a society, we still have a long way to go, so this book is a good starting point for an honest but not-so-taboo topic.