Grade Level: High School (9th—12th)

Piagetian Level: Formal Operations

Learners who have achieved formal operations are suited for this activity.

STEM *Science, Technology, Engineering, & Mathematics*

Learn & Grow Educational Series℠

Human-Caused Environmental Impact

Instructional Goals: Following instruction and participation, students will be able to design, evaluate, and refine a solution using self-watering bucket containers that reduces the impacts of plastic waste in landfills, wasted outdoor space (like empty lots or large, flat rooftops), and excessive water usage by humans.

Lines of Inquiry:

- What is the impact on landfill capacities of plastic 5-gallon buckets being thrown into the garbage?
- What is the impact of empty lots and other unused spaces in food desert neighborhoods?
- What is the impact of excessive human water consumption on the environment?
- How can self-watering container gardens address the issues of plastic waste, wasted space, and wasted water?

Materials:

Assignment 1 -

- Access to internet in your classroom for whole-class viewing of video

Assignments 2, 3, & 4 -

- Research & reference tools & materials
- Tools & materials to produce the assigned work product, whether it is a written report, PowerPoint® presentation, video, poster, or some other method of demonstrating mastery of the instructed concepts

Assignment 4 -

- Tools & materials for building out one self-watering container per student. (See http://learn-and-grow.org for instructions & materials)
- Organic potting soil with compost or fertilizer mixed into it—enough for each container
- Water for each self-watering container's reservoir
- Baby plants and/or seeds for each student according to his/her respective gardening plan proposal

Common Core Standards:

- RST.11-12.7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
- RST.9-10.8. Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
- RST.11-12.8. Evaluate the hypotheses, data, analysis, and conclusions of a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
- WHST.9-12-7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- MP.2. Reason abstractly and quantitatively.
- HSN-Q.A.1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
- HSN-Q.A.2. Define appropriate quantities for the purpose of descriptive modeling.
- HSN-Q.A.3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

CA State Standards—Science:

- HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

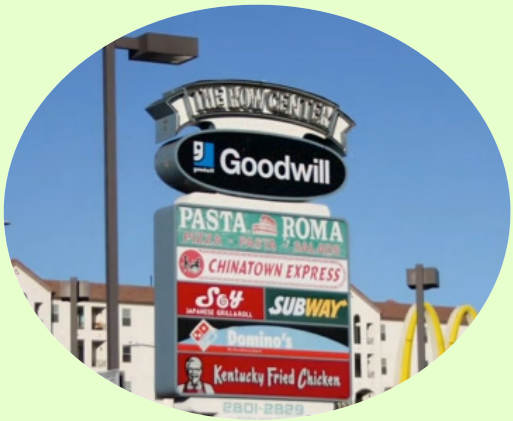
Human-Caused Environmental Impact, continued...

Instructions:

Assignment 1 -

1. Go to http://www.ted.com/talks/ron_finley_a_guerilla_gardener_in_south_central_la and watch the video with your class (Forewarning: Some mild swearing is included in this video, but the content is intellectually stimulating, ethically responsible, and engaging to most high school students).

2. Discuss with your class the impact of empty lots on residents of urban areas, such as South Central Los Angeles. Consider factors such as the opportunities that empty lots can provide for criminal and drug activity, the costs of putting them to commercial or residential use versus how much money could be made off them by their owners, the impact on taxpayers of empty lots owned by counties and municipalities, etc.



3. Discuss with your class the impact of food deserts on the health of residents in food desert neighborhoods. Consider costs of medical care, transportation to and from decent grocery stores, and costs of healthy foods versus fast food as they impact families from households with low socioeconomic status (SES); how many families from low-SES households live in food desert communities; the incident rate of disability among low-SES households; and the impact some disabilities have on individuals' abilities to travel beyond their immediate surroundings for healthy foods.

4. Discuss with your class how using empty lots in food desert neighborhoods for community gardening projects addresses the problems otherwise caused by empty lots and food desert conditions.

Assignment 2 -

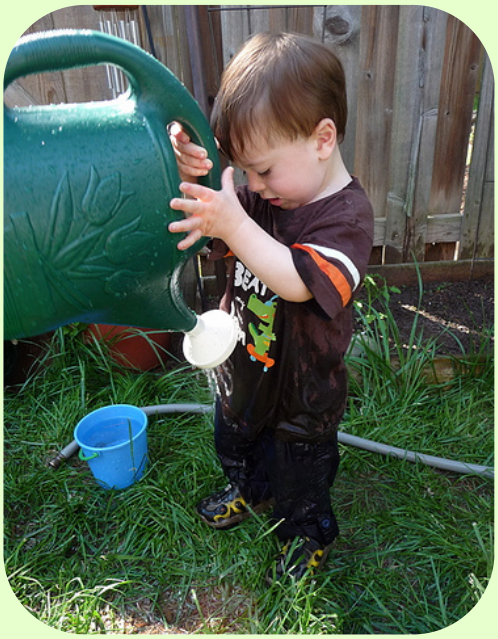
1. Have your students each conduct research of various media formats regarding the following topics:
   - The impact of plastic waste on landfills
   - The volume of food-safe plastic 3- and 5-gallon buckets produced for the American commercial food industry in a given year
   - The volume of these buckets that are disposed into landfills each year in the United States
   - Different applications for recycling food-safe buckets from the commercial food industry
2. Have your students each write a report, including images and graphics where appropriate, to represent their respective research findings. Their written works should each contain a conclusion regarding the importance of reusing and recycling plastics as they relate to the impact of human activities on the environment.

Human-Caused Environmental Impact, continued...

Assignment 3 -

1. Have your students conduct research of water consumption rates for various types of home and commercial fruit and vegetable growing.
2. Divide your class into small groups of 3-5 students.
3. Using their research notes, have the members of each group collaborate with each other on a 10-minute presentation to the class regarding an important aspect of water consumption as it relates to growing food, whether at home or for commercial purposes. For example, students could do projects on the topics of water evaporation rates, soil/water relationships, traditional home gardening water usage compared to commercial farming water usage, the impact of water usage by commercial farms operating in the desert, etc.

   - Each group should select its own topic, but each topic must be teacher-approved before the students can start their presentations.
   - Where possible, have students integrate the use of technology and/or the arts into their presentations.
   - Each group should prepare a written proposal that includes an introduction of its presentation topic, a synopsis of at least two reasons why it is an appropriate topic for this assignment, the nature of the presentation (PowerPoint®, video, live demonstration, performance art, etc.) and a description of the role each student will play in making the proposed presentation. Each proposal should be typed, double-spaced with one-inch margins to allow you space to add written feedback.
   - You should review the proposals for their topic relevance and conformity with the assignment guidelines, as well as provide written feedback as to any changes needed to bring the presentation into conformity with this assignment. Do not consider a proposal as "passing" until it conforms to the assignment; provide guided instruction to each group where necessary to help it develop its proposal so that it "passes." Try to keep this process limited to no more than one instructional week in duration, if possible.



   - Once you have approved the groups' proposals, each group has three instructional weeks to complete its presentation.
   - Students should be afforded adequate opportunities to conduct their research and collaborate on producing their final work product. Teacher assistance during in-class group collaboration times may be necessary, so it is recommended that groups be spaced throughout the classroom to allow you to move freely from one group to the next and to keep the conversations of each group from encroaching upon the conversations of its neighbors.
   - Schedule each group's presentation before the end of the three-week period during which your students are creating their presentations.
   - Upon the conclusion of three instructional weeks, have your groups present their topics to the rest of the class according to the schedule.
   - Have students evaluate each presentation using the Presentation Evaluation Form located in the Student Instructions and Data Sheets at the end of this lesson plan.

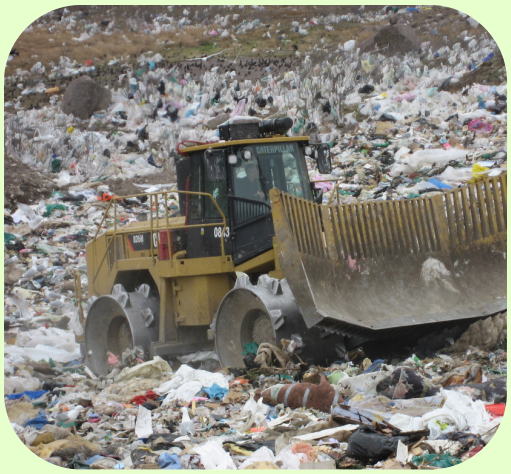
Human-Caused Environmental Impact, continued...

Assignment 4 -

1. Have your students research the self-watering container gardening strategies used by the Learn & Grow Educational Series (see http://learn-and-grow.org).
2. Have each student research different types of fruits and vegetables that can be grown in containers (see http://www.seedsnow.com/collections/seed-finder/grows-well-with-containers for examples).
3. Have each student research polyculture and determine which plants to grow in his/her individual self-watering bucket container.
4. Afford your students three instructional days to collect the necessary information both during instructional times and on their own.
5. Each student should provide you with a written gardening plan, developed in class and independently, that describes which plants will be grown in his/her container, the reasons why the selected plants are expected to grow well together, and the steps that will be taken to make sure the conditions favorable to the plants are maintained throughout the remainder of the growing season; this gardening plan is due three instructional days following the three-day research period and should be typed, double-spaced, with 1-inch margins and include a bibliography or reference list.
6. Review each gardening plan for logical choices of plants and reasons given for each particular polyculture mixture proposed; check your students' facts if you are unsure of their accuracy, provide written feedback on their proposed gardening plans, and provide guided instruction during in-class gardening plan development time.
7. Upon approval of their gardening plans, have your students build out a self-watering container garden (see http://learn-and-grow.org for instructions and a materials list), building one self-watering bucket container per student. Each student will care for the same container for the remainder of this experiment.
8. Have your students fill the upper chambers of their containers with soil and the reservoirs with water.
9. Have them plant their containers according to their individual gardening plans.
10. Have them collect data using the Data Sheets found in the Student Instructions & Data Sheets located at the end of this lesson plan for the next 90 calendar days.
11. At the end of 90 days, have them write a report (typed, double-spaced with 1-inch margins) that summarizes:
    - What their plants produced or are in the process of producing.
    - Any challenges (pests, weather, etc.) they've had to overcome in maintaining the plants in their containers
    - What value, if any, they perceive in growing their own food.
    - How the research they conducted regarding waste plastic, water conservation, and wasted space relate to the potential for self-watering container gardening projects in food desert communities.
    - A conclusion with at least one suggestion for a community service activity in which self-watering container gardens could be used to recycle used food-safe 3- and 5-gallon buckets, conserve water, and utilize wasted space.
    - Review each report for conformity with the assignment, appropriate use of English, accuracy of content, and apparent thoughtfulness and reasoning.

Where possible, children should be encouraged to eat the fruits and vegetables they grow in order to make the cognitive connections between growing food, where food comes from, how food provides fuel to the human body, and how healthy foods make a difference in how the mind and body feel and work. This also gives

Human-Caused Environmental Impact
Student Information & Data Sheets



Oftentimes, destructive environmental impact is not the result of a single cause. It can easily be the case that several factors combine together to create unique forms of negative environmental impact. On that basis, it can sometimes be the case that a single solution can address more than one problem.

Humans impact the environment in a number of ways, but we focus on three key areas, here: excessive water use in growing fruits and vegetables, plastic wastes in landfills, and wasted space in urban environments (particularly food desert neighborhoods).

Recycling food-safe 3- and 5-gallon buckets from grocery stores, bakeries, delis, restaurants, school cafeterias, etc., to build self-watering container gardens prevents the plastic from going into landfills. By using the subirrigation methods upon which self-watering containers rely, less water is used to grow each plant than is used in more traditional in-ground home gardening and commercial agriculture. By putting self-watering container gardens into empty lots in food desert neighborhoods, particularly paved and other types of lots unsuitable for in-ground gardening, the space produces food for the neighborhood rather than crime, loss, and suffering. Urban rooftops provide an otherwise wasted opportunity for gardening, and self-watering containers reduce the burden of supplying a growing environment and water to a rooftop garden.

Materials:

Assignment 1 -

- Access to internet in your classroom for whole-class viewing of video

Assignments 2, 3, & 4 -

- Research & reference tools & materials
- Tools & materials to produce the assigned work product, whether it is a written report, PowerPoint® presentation, video, poster, or some other method of demonstrating mastery of the instructed concepts

Assignment 4 -

- Tools & materials for building out one self-watering bucket container for your use (See http://learn-and-grow.org for instructions & materials)
- Enough organic potting soil with compost or fertilizer mixed into it for your container
- Water for your self-watering bucket container's reservoir
- Baby plants and/or seeds for your container per your approved gardening plan (read further for more information about your gardening plan)

Instructions:

Assignment 1 -

1. Go to http://www.ted.com/talks/ron_finley_a_guerilla_gardener_in_south_central_la and watch the video with your class (Forewarning: Some mild swearing is included in this video.)
2. Discuss with your class the impact of empty lots on residents of urban areas, such as South Central Los Angeles. Consider factors such as the opportunities that empty lots can provide for criminal and drug activity, the costs of putting them to commercial or residential use versus how much money could be made off them by their owners, the impact on taxpayers of empty lots owned by counties and municipalities, etc.

Human-Caused Environmental Impact
Student Information & Data Sheets

3. Discuss with your class the impact of food deserts on the health of residents in food desert neighborhoods. Consider costs of medical care, transportation to and from decent grocery stores, and costs of healthy foods versus fast food as they impact families from households with low socioeconomic status (SES). Also discuss how many families from low-SES households live in food desert communities; the incident rate of disability among low-SES households; and the impact some disabilities have on individuals' abilities to travel beyond their immediate surroundings for healthy foods.

4. Discuss with your class how using empty lots in food desert neighborhoods for community gardening projects addresses the problems otherwise associated with these spaces.

Assignment 2 -

1. Conduct research of various media formats regarding the following topics:
   - The impact of plastic waste on landfills
   - The volume of food-safe plastic 3- and 5-gallon buckets produced for the American commercial food industry in a given year
   - The volume of these buckets that are disposed into landfills each year in the United States
   - Different applications for recycling food-safe buckets from the commercial food industry
2. Write a report, including images and graphics where appropriate, to represent your research findings. Your written work should contain a conclusion regarding the importance of reusing and recycling plastics as they relate to the impact of human activities on the environment.

Assignment 3 -

1. Conduct research of water consumption rates for various types of home and commercial fruit and vegetable growing.
2. Join a group, as directed by your teacher.
3. Collaborate with your group partners on a 10-minute presentation to the class regarding an important aspect of water consumption as it relates to growing food,

whether at home or for commercial purposes. For example, groups could do projects on the topics of water evaporation rates, soil/water relationships, traditional home gardening water usage compared to commercial farming water usage, the impact of water usage by commercial farms operating in the desert, etc.

- Each group should select its own topic, but each topic must be teacher-approved before groups can start their presentations.
- Where possible, integrate the use of technology and/or the arts into your group's presentation.
- With your group, prepare a written proposal that includes an introduction of your group's presentation topic, a synopsis of at least two reasons why it is an appropriate topic for this assignment, the nature of the presentation (PowerPoint®, video, live demonstration,

Human-Caused Environmental Impact
Student Information & Data Sheets

performance art, etc.) and a description of the role each student will play in making the proposed presentation. Each proposal should be typed, double-spaced with one-inch margins.

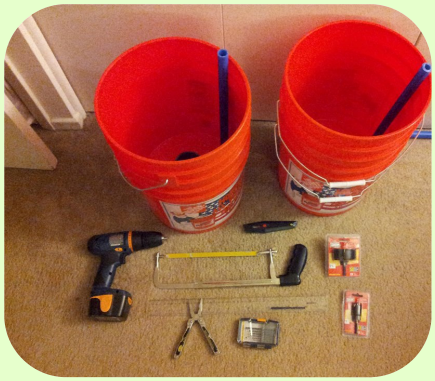
- Your teacher will review the proposals for their topic relevance and conformity with the assignment guidelines, as well as provide written feedback as to any changes needed to bring the presentation into conformity with this assignment.
- Upon approval of your group's proposal, your group has three instructional weeks to complete its presentation.
- Upon the conclusion of three instructional weeks, your group will present its topic to the rest of the class according to a schedule previously arranged by your teacher.
- Evaluate each of the other groups' presentations using the Presentation Evaluation Form located at the end of these instructions.

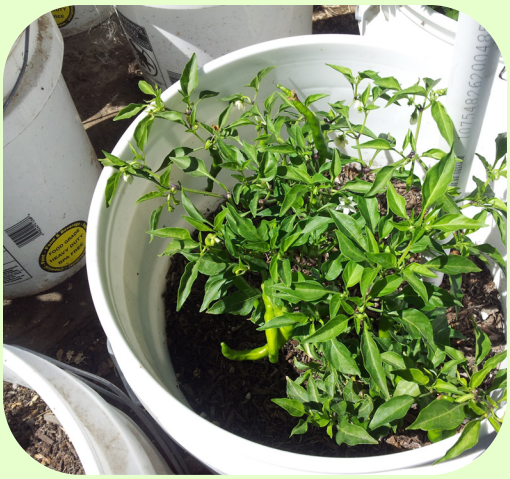
Assignment 4 -

1. Research the self-watering container gardening strategies used by the Learn & Grow Educational Series (see http://learn-and-grow.org).
2. Research different types of fruits and vegetables that can be grown in containers (see http://www.seedsnow.com/collections/seed-finder/grows-well-with-containers for examples).
3. Research polyculture and determine which plants to grow in your self-watering bucket container.
4. Collect all your research data over the next three instructional days and get it organized.
5. Write and turn in a written gardening plan, developed in class and independently, that describes which plants will be grown in your container, the reasons why the selected plants are expected to grow well together, and the steps that will be taken to make sure the conditions favorable to the plants are maintained throughout the remainder of the growing season; this gardening plan is due three instructional days following the three-day research period and should be typed, double-spaced, with 1-inch margins and include a bibliography or reference list.
6. Your gardening plan will be reviewed by your teacher for logical choices of plants and reasons given for your particular proposed polyculture mixture.
7. Upon approval of your gardening plan, build out a self-watering container (see http://learn-and-grow.org for instructions and a materials list) to go into a classroom garden. You will care for the same container in the garden for the remainder of this experiment.
8. Fill the upper chambers of your container with soil and the reservoir with water.
9. Plant your container according to your approved gardening plan.

Human-Caused Environmental Impact
Student Information & Data Sheets

10. Collect data using the Data Sheets, found at the end of these instructions, for the next 90 calendar days.
11. At the end of 90 days, write a report (typed, double-spaced, with 1-inch margins) that summarizes:
    - What your plants produced or are in the process of producing, any challenges (pests, weather, etc.) you've had to overcome in maintaining the plants in your container.
    - What value, if any, you perceive in growing your own food.
    - How the research you conducted regarding waste plastic, water conservation, and wasted space relates to the potential for self-watering container gardening projects in food desert communities.
    - A conclusion with at least one suggestion for a community service activity in which self-watering container gardens could be used to recycle used food-safe 3- and 5-gallon buckets, conserve water, and utilize wasted space.
    - Each report will be reviewed by your teacher for conformity with the assignment, appropriate use of English, accuracy of content, and apparent thoughtfulness and reasoning.





Piagetian Level: Formal Operations

Human-Caused Environmental Impact
Student Information & Data Sheets

NOTE: Please print/copy enough of *this page and the next* so that each student has one evaluation form per group.

Name: _____

Presentation Evaluations

Group Number	_____
Presentation Topic	_____
1. Did the group appear to share responsibility among its members for creating and giving the presentation?	☐ Yes ☐ No What makes you say that? _____ _____
2. Was the information presented based on solid research and evidence, in your opinion?	☐ Yes ☐ No What makes you say that? _____ _____
3. Was the information presented in a way that made it understandable to you?	☐ Yes ☐ No What makes you say that? _____ _____
4. In what ways does the information shared by this group relate to your own knowledge and research?	_____ _____ _____ _____ _____ _____

Human-Caused Environmental Impact
Student Information & Data Sheets

Name: _____

Presentation Evaluations

Group Number	_____
Presentation Topic	_____
5. Do you think anything important was missing from this group's presentation?	☐ Yes ☐ No What makes you say that? _____
6. Did you learn anything from this presentation that you didn't already know?	☐ Yes ☐ No What makes you say that? _____
7. Did you learn anything from this presentation that you can do in your own life to conserve water?	☐ Yes ☐ No What makes you say that? _____
8. What recommendations, if any, would you make for improvements in this group's presentation?	_____

Human-Caused Environmental Impact
Student Information & Data Sheets

90-Day Data Collection Sheets

Name: _____

Polyculture combination: _____

Soil qualities/requirements: _____

_____

List the dates on which you harvested produce from your self-watering bucket container, along with the types and quantities of produce you harvested:

Date:	Type of Fruit/Vegetable:	Quantity:

Human-Caused Environmental Impact
Student Information & Data Sheets

90-Day Data Collection Sheets

Describe any challenges you've faced with your self-watering bucket container and its plants over the last 90 days (pests, weather, etc.) and how you resolved them:

_____

_____

_____

_____

_____

_____

_____

_____

_____

Log the dates when you add water and fertilizer to your self-watering bucket container. Also record the type of fertilizer you use each time.

Watering Date	Fertilizer Date	Fertilizer Type