A COMMON CORE CURRICULUM GUIDE TO

HELLO FROM 2030

THE SCIENCE OF THE FUTURE AND YOU

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Summary

Hello from 2030 provides insight into many of the conflicts that are seen in the world, and how they may unfold in the years to come. Young scientists will marvel at the possibilities the future beholds, and we hope to inspire the inventor of the next gadget or energy source that changes the world. When using this book to brainstorm for classroom activities (aside from the ones listed), ask your students what the benefits are regarding these highly evolved devices. Have them consider growing up in a world that has more advanced technology, yes, but will also be filled with conflict. The world in which we live is at a turning point, and during your students' education, there are likely going to be considerable changes to the planet—politically and socially, as well as environmentally. This book is an honest insight into the possible landscape of our future and is intended to assist students in conceptualizing how current actions affect the future.

Hello from 2030 includes facts and analysis from recent research in a projection of the future as it is seen through the lens of scientists across the globe. The subject matter is written to fulfill common core standards for grades 3-7.

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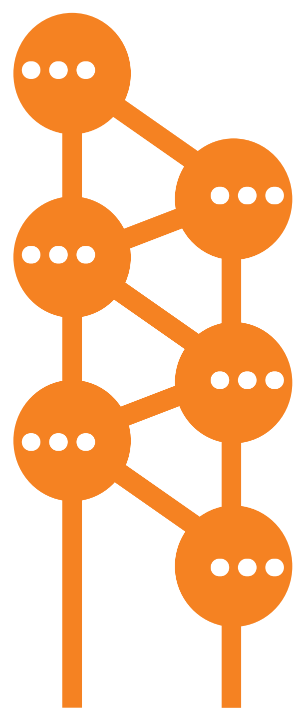


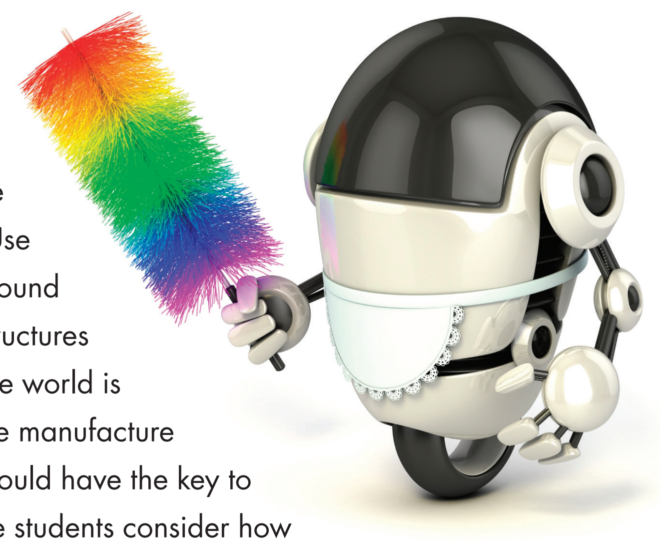
> USING FUTUROLOGY IN THE CLASSROOM

Why should you bother teaching this book? Technology is rapidly changing the ways in which we live, and this book provides things to consider about the benefits and dangers that can come from this advancement. There is a line between science fact and science fiction, and this book attempts to walk it. There is no fundamental curriculum for futurology, but this guide will attempt to provide a foundation for using it to generate insight.

Students in the target range are beginning to develop the ability to empathize with others and view their effects on the world around them. Technological advances are a fun way to think about the future, but necessity is the driving force for many of these advancements, and the survival of our species depends on advancements in energy, medicine, and renewable materials. This guide will provide writing prompts, lesson plans, and tips on using the text in the classroom.

> DISCUSSION QUESTIONS AND WRITING PROMPTS

CHAPTER 1: A TOUR OF YOUR NEW HOME



This chapter inspires critical thinking and discussion around what homes of the future will be like. There is an overview of the types of advancements there may be in the future to enhance efficiency and decrease clutter. Use this chapter to engage conversation or writing activity around the materials used in the building of houses and other structures and the benefits of natural versus man-made structures. The world is at a point in which changes could be made in the way we manufacture certain goods. Inspire the idea that any of your students could have the key to solving the energy crisis locked away in their heads! Have students consider how they would "power the planet" in a perfect world.

CHAPTER 2: SPACESHIP EARTH

Humans have caused enough damage to rouse the planet's sixth mass extinction. The thought that our existence on this planet could be finite is tough for many students to conceptualize, but unless a change in perspective is made early on, the world is in for more trouble. Inspire students to be the change the world needs. Have students write about how their current lifestyle and consumption habits could be seen by future generations. As an ongoing activity, encourage your classroom (or even the whole school) to reach a total goal of 75–90 percent recycling of all materials used on the school premise. Encourage them to try this at home with their families too.

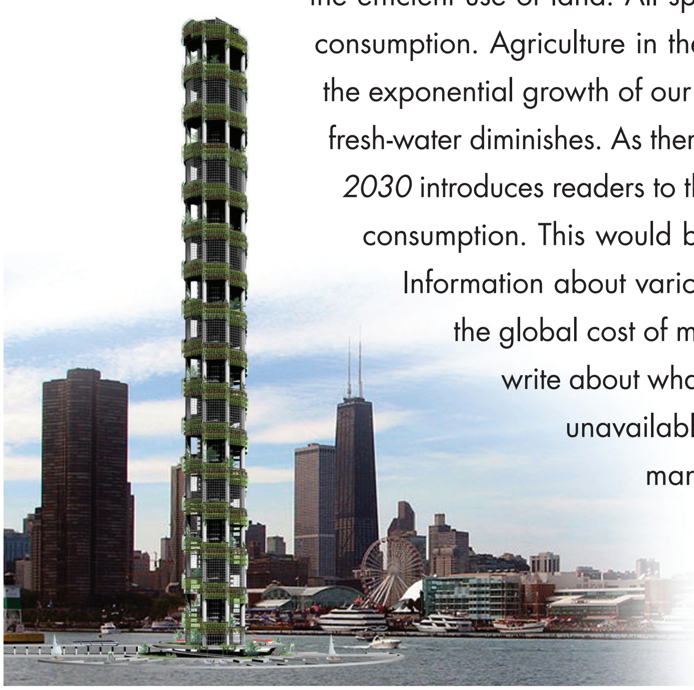
CHAPTER 3: FROM DIRTY HUMAN TO "GREEN" AS AN ANT

This chapter outlines the impact humans have on the environment. Some emphasis is placed on industry and the effects of plastics on natural environments. Humans are more wasteful than the rest of nature, and one thing to relay to students is the importance of incorporating reusable materials into their lives as a norm. As genetic science continues to progress, we continue to theorize about the possibility of recreating some of the planet's lost species. Have students write about which animal they would prefer to bring back from extinction, given the opportunity. What impact would this animal have on the planet and the species alive today?

CHAPTER 4: HOW DO YOU PREDICT THE FUTURE?

This chapter fosters curiosity around the science of futurology. Your students will learn how futurologists use historical data to make predictions in areas such as new technologies, what resources and energy consumption we will need, and even what the future global map may look like when it comes to governments. The foundation of science is scientific research. This chapter explains the importance of learning how to find and interpret information from the past and present. Use this when explaining the importance of their research projects.

CHAPTER 5: BREAD AND WATER



As the human population continues to grow, a storyline for our future is food production and the efficient use of land. All species have a population capacity that is tethered to resource consumption. Agriculture in the future may need to undergo some changes to keep up with the exponential growth of our species. As the planet grows warmer, the amount of available fresh-water diminishes. As there are more humans, there is less water to go around. *Hello from 2030* introduces readers to the idea of water collection and the importance of limiting water consumption. This would be a good section to use for an intro to population dynamics. Information about various food types are present in the text, but a recurring theme is the global cost of meat and other high quality protein consumption. Have students write about what could happen if any one food source becomes scarce or even unavailable. Ask them to write about their feelings regarding genetically manufactured foods, and some of the benefits or consequences. Another topic covered is the amount of water used for common items such as clothing. Students would be amazed to learn the environmental costs of some of their clothes (like their favorite pair of jeans!).

CHAPTER 6: SICK DAYS IN THE FUTURE? GOODBYE!

One of the most marvelous aspects of technology development includes advances in healthcare, stretching the preconceived notions of healing rates and physical ability. Students will be interested in learning about the chemical composition of body tissues, and how creating organs in a laboratory is possible (even 3D printing of body parts). This chapter provides lead-ins to the subject of disease and disease prevention. Advances in healthcare will continue to improve and there is an open door to big thinkers (and doers) who want to be a part of this future. Have students write about which disease they think will be cured in fifteen years or how artificially created body parts could change the medical industry. Ask them to write about a disease they'd like to tackle themselves.

CHAPTER 7: THE AGE OF THE ROBOT

For decades, humans have been using machinery to complete tasks and make life easier. The effects of robots on our lives are destined to increase, and whether we talk about manufacturing robots or a robo-butler, they will have a big impact on our future. This chapter outlines human constraints, as well as the effects man-hours have on labor and industry. When we think about futuristic gadgets, the possibilities are endless—brain computers and invisibility suits included. Have your students write about a gadget they would like to invent. Engage your classroom in a discussion around how having highways and roads filled with self-driving cars could impact our daily lives in the future. Ask about the myriad ways this could improve our lives. What other industries would be affected by this change?

1. HOUSE OF THE FUTURE

Objective: Students will calculate their energy and water consumption and be able to compare the efficiency of their current homes compared to how they are projected to be in 2030.

Essential Question: How important is hypothetical creativity to a developing imagination and the advancement of our society?

Procedure: Your students are recent homebuyers who found their dream home. Unfortunately it needs a few modifications to be brought up to code. In 2030 all houses need to be on the solar grid, they must collect and reuse rainwater, and structural modifications must be made with the use of renewable materials. Students will design their future house in two parts:

Part 1: Students will choose the appliances they want in their home and calculate the cost of powering it. Using the appliance wattage reference sheet provided, students will add the power consumption of their appliances, lights, and temperature control. Students will take the data that is collected from adding their power consumption and determine the amount of energy they will consume in a year.

One kilowatt-hour (1 kWh) means an energy source supplies 1,000 watts (1 kW) of energy for one hour. Once they have the annual consumption for their house, students can determine how much energy their house will need to be independently sustainable.

Currently, modern solar panels produce 8–10 watts per square foot of panel area; it is acceptable to assume in 2030 one panel will produce 60–75 watts per square foot (according to Moore's Law).

Today, if a student's house consumes 10,000 kWh (kilowatts per hour) annually, it will take 1000 square feet (or half of a singles tennis court) of solar panels to produce enough energy to power their house on solar energy. In 2030, it will take 133 square feet of solar panels to make the same amount of electricity.

Part 2: After calculating their power consumption, students should calculate their water consumption according to the size of their family. Students are to determine how much water can be saved by collecting the rainwater in their state (see resources).

Average water consumption per person: http://environment.nationalgeographic.com/environment/freshwater/change-the-course/water-footprint-calculator/.

To determine the amount of water that could be saved by collecting rainwater, students will first need to calculate the area of the roofs on their houses, and then determine the average rainfall in the area they live.

To calculate how much rainwater could be harvested use this formula: Harvested water (gal) = Area of roof × Rainfall depth (in) × 0.623 (conversion factor). If 40 inches of rain falls annually in Portland, Oregon in 2030, a student whose house has a roof measuring 100 squre feet will catch 2,492 gallons of water for reuse each year.

Students will pick a house size from a generic list of house sizes and roof areas.

Materials: Students will need the wattage reference sheet and graph paper.

Resources: Map of US average rainfall by state: http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring/usa.shtml.

Average solar radiation by state: http://www.nrel.gov/gis/solar.html.

Assessments: With the increase in population size, states will be using more water, and with unpredictable weather patterns, there may be less water to go around. Have your students consider why it's important to collect water, rather than allowing it to drain down the streets and into the sewers. Assess the accuracy of the student's math, as well as completion of the activities. Students must recognize that there are benefits to reusing construction materials, and that it will continue to be more cost-effective to use solar power in the future. A follow-up activity involving critical writing is encouraged to assess the students' level of understanding with the material.

HOUSE OF THE FUTURE: COMMON CORE STATE STANDARDS

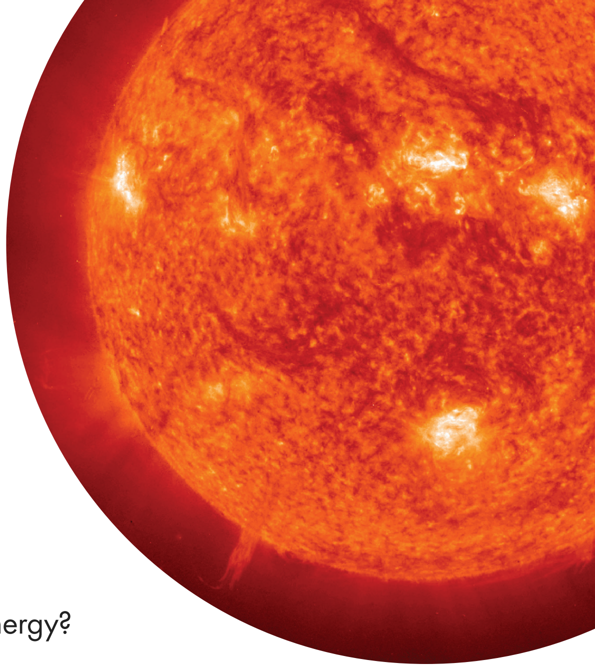
Science

4-PS3-2: Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
4-PS3-4: Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
4-ESS3-2: Generate and compare multiple solutions to reduce the impacts of natural earth processes on humans.
5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
MS-LS2-1: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
MS-LS2-2: Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
MS-LS2-3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

Mathematics

3.OA.A.3: Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurements quantities, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.
3.OA.A.4: Determine the unknown whole number in a multiplication or division equation relating three whole numbers.
3.MD.C.6: Measure areas by counting unit squares (square centimeters, square meters, square inches, square feet, and improvised units).
4.OA.A.1: Interpret a multiplication equation as a comparison, example, interpret 35 equals five times seven as a statement that 35 is five times as many as seven and seven times as many as five. Represent verbal statements of multiplicative comparisons as multiplication equations.
4.NBT.B.4: Fluently add and subtract multi digit whole numbers using the standard algorithm.
4.NTB.B.5: Multiply a whole number of up to four digits by and one-digit number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations.
4.MD.A.3: Apply the area and perimeter formulas for rectangles in the real world and mathematical problems.
5.OA.A.2: Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them.
5.NBT.A.4: Use place a value understanding to round decimals to any place.
5.NBT.B.5: Fluently Multiply multi digit whole numbers using the standard algorithm.
5.NTB.B.6: Find whole number quotients of whole numbers with up to four digit dividends and two digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.
5.NF.B.6: Solve real world problems involving multiplication of fractions and mixed numbers.
6.NS.B.2: Fluently divide multi-digit numbers using the standard algorithm.
6.EE.B.5: Understand solving an equation for inequality as a process of answering a question: which values from a specified set, if any, makes the equation or inequality true?
6.EE.B.6: Use variables to represent numbers and write expressions when solving a real world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.
6.EE.B.7: If solve real world and mathematical problems by writing and solving equations of the form $x+p=q$ and $px=q$ for cases in which p, q and x are all nonnegative rational numbers.
7.RP.A.2: Recognize and represent proportional relationships between quantities.
7.RP.A.3: Use proportional relationships to solve multi-step ratio and percent problems.
7.EE.B.4: Use variables to represent quantities in a real world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

2. SOLAR EFFICIENCY LESSON



Objective: Students will know how the sun's energy is transferred to the Earth. Students will be able to calculate and understand that it is the speed and efficiency of solar technology that will advance into the future. Students must design a solar powered device and must calculate how long it will charge and last once it is charged.

Essential question: Why is it important to have your students consider the benefits of solar power?

Procedure: Warm up: ask students to answer the question: What is energy?

Brief introduction to the "Law of Conservation of Energy" which states that energy cannot be created or destroyed; it can only be transformed into another form of energy. An introduction to waves and the visible spectrum of light would provide background information to help students understand the existence of photons and how power collected from the sun can vary due to the intensity of rays that strike the photovoltaic cell. Explain how to conceptualize the movement of electricity as electrons moving in the same direction (electrons are the negative particles flying around an atom). Photovoltaic cells are designed to collect electrons from the atoms in sunlight. As sunlight hits solar panels, the electrons are shaken free and move around the device in search of a place to be stored. An electric current is defined as electrons moving in the same direction. As solar cells collect electrons from the sun, different layers of PV panels separate and create room for electrons to move. Electrons travel from the surface mirror through layers of PV cells and are stored in the solar battery cell. In the process of collecting sunlight, a large portion of electrons is lost because the method of electron storage is not operating quickly enough to collect everything. Light strikes the first layer of PV cells and shakes off some electrons. These electrons move down through the layers of cells in the solar array. As sunlight continues to strike the array, electrons a few layers down into the PV cell have not yet been stored as electricity in the solar battery. Explain to students that the loss of electrons due to the speed of electron transfer is called solar cell efficiency. SCE is calculated by dividing a cell's power output (Pm, in max watts) by the input light (E, in W/m2) and the surface area of the solar cell (Ac, in m2); represented as:

$$\eta = \frac{P_m}{E \times A_c}$$

The increased level of efficiency will allow the development of devices with photovoltaic cells that collect more energy than modern solar devices today. The amount of explanation regarding SCE can be scaled to the level of your students. Ideally, they need to understand that the technology is becoming more useful as it becomes more efficient.

Your students are to design a solar device. After brainstorming to come up with an idea, they will need to determine the size of their device. Size determines the amount of energy it will need to work, and ultimately, the length of time it will take to charge. They can compare the size, wattage, and battery life of their inventions to the appliance wattage chart for a sense of reference.

To determine the amount of time it takes to charge a solar device, the size of the battery is important. Batteries scale to the size of the device, and a chart listing the battery life of today's solar devices is listed on the wattage handout. Batteries are measured in amperes (amps), and one amp is equivalent to one hour of battery use. To calculate the proper amount of wattage necessary for a battery to power your device, use the formula: Watts = Volts × Amps.

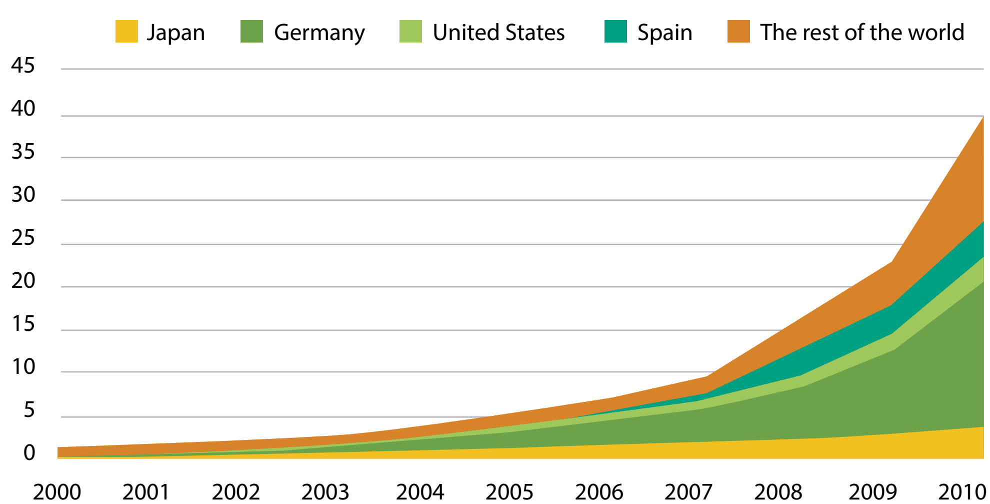
For the sake of the assignment, use 12V as a standard for voltage in these calculations, and a solar panel of 85 watts.

Currently solar cells have a 20 precent conversion rate, and the maximum possible conversion efficiency rate is 86 percent. This means that a 12 volt 45 amp battery requiring 540 watts will take 6 hours to charge, and will run for 45 hours. In 2030, this same device will take 48 minutes to charge.

Materials: Diagrams of solar collectors, reference materials, drawing supplies, average solar energy production by state.

References:
http://www.energymatters.com.au/education/solar-kids-teens/
http://www.nrel.gov/gis/solar.html

Assessment: Teachers will check the accuracy of student's math. The numbers used can be scaled down to suit skill level.



SOLAR EFFICIENCY LESSON: COMMON CORE STATE STANDARDS

Science:

3-5-ETS1-1: Define a simple design problem reflecting a need or want that includes specific criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

4-PS3-2: Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

4-PS3-4: Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

5-PS1-1: Develop a model to describe matter is made up of particles too small to see.

5-PS3-1: Use models to describe that energy in animals food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.

MS-LS2-3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

Mathematics:

3.OA.A.3: Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurements quantities, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.

3.OA.A.4: Determine the unknown whole number in a multiplication or division equation relating three whole numbers.

4.OA.A.1: Interpret a multiplication equation as a comparison, example, interpret 35 equals five times seven as a statement that 35 is five times as many as seven and seven times as many as five. Represent verbal statements of multiplicative comparisons as multiplication equations.

4.NBT.B.4: Fluently add and subtract multi digit whole numbers using the standard algorithm.

4.NTB.B.5: Multiply a whole number of up to four digits by and one-digit number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations.

5.OA.A.2: Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them.

5.NBT.A.4: Use place a value understanding to round decimals to any place.

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5.NTB.B.6: Find whole number quotients of whole numbers with up to four digit dividends and two digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.

5.NF.B.6: Solve real world problems involving multiplication of fractions and mixed numbers.

6.NS.B.2: Fluently divide multi-digit numbers using the standard algorithm.

6.EE.B.5: Understand solving an equation for inequality as a process of answering a question: which values from a specified set, if any, makes the equation or inequality true?

6.EE.B.6: Use variables to represent numbers and write expressions when solving a real world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.

6.EE.B.7: If solve real world and mathematical problems by writing and solving equations of the form $x+p=q$ and $px=q$ for cases in which p, q and x are all nonnegative rational numbers.

7.EE.B.4: Use variables to represent quantities in a real world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

3. CITY OF THE FUTURE

Objective: Students will be able to identify the advantages of renewable resources in an urban environment. Students will learn the amount of agricultural land it takes to feed a city and that resources such as food and water have finite availabilities. Students will learn how much water can be saved by collecting rainwater.

Setup: Students are representatives in the city of Futuropolis. Futuropolis recently crumbled underneath a massive earthquake and each student group represents a cabinet of government employees tasked to rebuild the structures lost in the disaster. To re-establish their crumbled city, groups must rebuild the advanced renewable resource the mayor has assigned to them.

Essential Questions: How important is it to know where your food and water come from? What are the benefits and consequences of society shifting to more urban-centered living standards?

Procedure: This lesson can be used in a variety of ways at the discretion of the teacher. The lesson can be instructed focusing on the pros and cons of each technological advancement, or students can be divided into groups that research their advancement independently. Students should be proficient enough in the subject matter to be able to present their findings to the class or write a paper describing the importance of their utility to future cities.

LESSON METHOD 1:

Advancements of Futuropolis: Water Collection and Recycling Center

In the future, water is much harder to come by. Increased global temperatures have increased the likelihood of droughts, and have forced people to recycle all of their water and collect rainwater. Have your students design a system of collecting water for reuse. Sewer systems should drain to the same location where water can be treated and reused, as well as basins beneath large buildings. Have them consider collection methods like gutters and tarps, and have your students develop plans for municipal runoff as well as large building water recycling.

Example: New York City currently averages about 50 inches of rainfall each year, and the surface area of the city is 469 square miles (1.214 square kilometers) or approximately 1.3 billion square feet. Using the water harvesting formula to determine the amount of water that goes uncollected (Harvested water (gal) = Area (ft^2) × rainfall depth (in) × 0.623), we can calculate that New York City has a water harvest potential of 4.05 trillion gallons annually.

Advanced agriculture: In the future, irrigating large fields has become a thing of the past. This group must build a skyscraper farm from the ground up! The farm must provide food for the ten thousand people who live in Futuropolis. Have students consider feeding their animals with food harvested from different areas of the farm and other sustainable aspects of having a self sufficient agriculture industry. Consider a brainstorming session at the front of the class to help inspire ideas about taking space into consideration when growing food. Currently in the US it takes about an acre of farmland to feed one person per year. They will be unable to make a model large enough to be to scale, but we can assume skyscraper agriculture will allow the ratio of food to land to decrease. For models, cardboard and duct-tape are appropriate supplies, as well as paper plates or construction paper. Having your students design a farm with labeled levels on pieces of paper will help conceptualize maximizing the production of their facilities with a limited amount of space. Have students calculate water collection using the equation for water harvesting (shown below), and explain why it would be useful for farms to collect the water that falls on their land.

Harvested water (gal) = Area of roof (ft^2) × Rainfall depth (in) × 0.623

Solar power plant: Solar power is the primary source of electricity for the city of Futuropolis, therefore, the solar power plant will be connected to the survival of many Futuropolians. Students will need to calculate the amount of solar panel coverage (in ft^2) required to power the grid of a major city. Which city used for the activity is at the discretion of the teacher. To calculate this, take the amount of power the city uses annually divided by 365, then multiply by 8–10 and 60–75 kWh per square foot of solar paneling for today's technology compared to tomorrow's respectively.

Example: New York City uses 11,000 MWh (mega watts per hour) each day, which is the same as saying it uses 11 billion Wh (watts per hour each day. Today, solar panels produce [on average] 8–10 kWh per square foot each day [or 800–1,000 Wh daily]. This means it would take about 1.4 million square feet of solar panels to power New York each day or about 24 football fields of surface area. According to Moore's Law, solar efficiency should be approximately 7.5 times more efficient than they are today, therefore, after finding the solar surface area it would take to power their city today, divide that number by 7.5 to get how much space it would take to power the same city with the advanced technology of the future—186,667 square feet or about 3.24 football fields in the case of New York City.

LESSON METHOD 2:

Another method of instruction could be used with the theme of this lesson. The lesson could be part of a daily exercise in community management, resource acquisition, and energy conservation. To make the lesson more of an educational boardgame, a space will be required where your students can leave the project to be left alone for as long as the lesson takes to. In keeping the theme of rebuilding a city, you could have an empty sandbox, or you could have a flat surface with a collection of Lego bricks, lincoln logs, or any other form of construction set. Allow the students to rebuild some of their city with a set amount of currency. To establish a baseline for currency, pieces of whatever construction method the students are using to build the city should be used (logs, popsicle sticks, legos). Students will receive a certain amount of currency to build structures within the city as part of their "budgeted income." If desired, an overview of economics can be worked in by fluctuating the income your students receive due to "market fluctuations." Compound interest can be incorporated if you want to establish a system where they can take loans out from the city bank to build more structures.

The goal of the activity shifts with this method. Your students should be attempting to decrease their environmental impact. Your students need to build houses for their residents and provide food and water for them. Since water is so critical in agriculture, it will be the regulating factor in population growth for this lesson. As students start to recycle their water, they will have more water for food and more food for their residents.

At the end of a set amount of time, your students need to upgrade their houses to solar energy, construct rain recycling channels, and feed their residents using a water and energy-efficient method. As students upgrade their structures, they will receive sustainability points. The goal of the lesson is to upgrade all of their structures and have the most sustainability points out of all of the teams.

Structure costs: Structures will cost part of their budget. A table (below) has been created as an example. The impact factor is scaled down when upgrades are built, and students will want to finish with the lowest score possible.

Impact factor: All man-made structures have an impact on the environment; with advanced technology we can reduce that impact. Each structure has been assigned a value, and when students upgrade their structures they lower that structure's impact.

Building houses: Each team will have the same number of residents (and houses) to start. Students can build houses with their budgeted income, or they can take loans from the city bank and pay back with interest.

Budgeted income: Students will receive enough capital to build one house or make one upgrade per class period.

Sustainability points: The value each structure holds in relation to its impact factor in context to the game.

Futuropolis resource breakdown:

Type of Structure	Energy Cost	Supply Cost	Impact Factor (IF)	IF with Solar	Solar Upgrade Cost	IF with Water Recycling	Water Upgrade Cost	IF With Both	Sustain-ability Points
Small house	50 kWw	20	4	3	10	3	10	2	2
Large house	100 kWk	40	6	4	15	4	15	1	3
Farm	800 kWk	N/A	12	9	30	6	30	3	3
Solar plant	1200 kWk	50	8			3	40		3
Solar upgrade	N/A	15							

Resources: Teachers will have discretion to use supplies varying from construction paper, erector sets, Lego bricks, or a sand box on a table. Supplies of any sort can be used to model the technological advancements mentioned above.

Assessment: There are a few different methods to assess the students' knowledge of the material. Students will be assessed on their ability to work in a group and develop strategies by filling out assessments for their teammates (printable pdfs can be found online) and by visual formative checks made by the instructor to ensure group stability.

Method 1: The students should be assessed on a sliding scale according to grade level regarding the development of their industry advancement, the ideas they produce, and completion of the assignment. The size of numbers can (should) be scaled down for lower grade levels, and the accuracy of students' calculations is assessable.

Method 2: An essay describing the different nuances of the lesson should be completed after the assignment has come to completion. The contents of each essay should be a reflection on what the teacher has incorporated into the lesson and an analysis of the importance of resources to an urban environment.

CITY OF THE FUTURE: COMMON CORE STATE STANDARDS

Science:

3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
3-LS1-1: develop models to describe that organisms have unique and diverse life cycles but all have common birth, growth, reproduction, and death.
3-LS4-3: Construct an argument with evidence that in a particular habitat some organisms survive well, some survive less well, and some cannot survive at all.
3-LS4-4: Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.
3-ESS3-1: Make a claim about the merit of a design solution that reduces the impacts of a weather related hazard.
4-LS1-1: Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
4-ESS3-2: Generate and compare multiple solutions to reduce the impacts of natural earth processes on humans.
5-PS3-1: use models to describe that energy in animals food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.
5-LS-1: Support an argument that plants get the materials they need for growth chiefly from air and water.
5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
MS-PS1-3: Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
MS-LS1-4: Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic of animal behavior and specialized plant structures affect the probability of success for reproduction of animals and plants respectively.
MS-LS1-6: Construct a scientific explanation based on evidence for the role of photosynthesis and the cycling and of matter into and out of organisms.
MS-LS1-7: Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support group and/or release energy as this matter moves through an organism.
MS-LS2-1: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
MS-LS2-3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
MS-LS2-4: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
MS-LS2-5: Evaluate competing design solutions for maintaining biodiversity and the ecosystems services.

Mathematics:

3.OA.A.3: Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurements quantities, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.
3.OA.A.4: Determine the unknown whole number in a multiplication or division equation relating three whole numbers.
3.MD.B.4: Generate measurements data by measuring links using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off an appropriate units - whole numbers, halves, or quarters.
3.MD.C.6: Measure areas by counting unit squares (square centimeters, square meters, square inches, square feet, and improvised units).
4.OA.A.1: Interpret a multiplication equation as a comparison, example, interpret 35 equals five times seven as a statement that 35 is five times as many as seven and seven times as many as five. Represent verbal statements of multiplicative comparisons

as multiplication equations.

4.NTB.B.5: Multiply a whole number of up to four digits by and one-digit number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations.

4.MD.A.3: Apply the area and perimeter formulas for rectangles in the real world and mathematical problems.

6.NS.B.2: Fluently divide multi-digit numbers using the standard algorithm.

6.EE.B.5: Understand solving an equation for inequality as a process of answering a question: which values from a specified set, if any, makes the equation or inequality true?

6.EE.B.6: Use variables to represent numbers and write expressions when solving a real world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.

6.EE.B.7: If solve real world and mathematical problems by writing and solving equations of the form $x+p=q$ and $px=q$ for cases in which p, q and x are all nonnegative rational numbers.

7.RP.A.2: Recognize and represent proportional relationships between quantities.

7.EE.B.4: Use variables to represent quantities in a real world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

4. ROBOT FACTORY

Objective: Students will design and draw a robot that resolves an issue not covered by technology today. They will present their creation to the class as if it is the boardroom of a robotics company and will argue that their product is what the world is waiting for!

Setup: Your students have recently been hired as workers at a robot factory. The head of marketing wants their idea for a new robot that will change people's lives. Have your students brainstorm the benefits robots could bring to daily life and have them design their ideal robot of the future.

Procedure: To start, cover a history of the advancement of robotic technology throughout the years. Consider creating a slideshow with pictures to show students how robots have increased in their ability to move and perform tasks. Your students will need to consider what type of robot they want to build. Where with this robot be most suitable to use? Will their robot have track treds or legs? Will the robot be able to come inside their house? How will their feet stay clean? Have your students consider the needs of people that are not being met by today's technology, and have them attempt to solve the problem they have established.

Materials: Students will need poster paper, markers, and their imaginations.

Resources: http://www.sciencekids.co.nz/sciencefacts/technology/historyofrobotics.html

Assessment: Have students write a paragraph describing their robot. Make sure they mention the need their robot meets not covered by today's technology. Your students should be able to explain that the design for their robot was made possible due to the advances made in technology throughout history. To provide advanced curriculum, assess the ability of the students design to solve their problem.

ROBOT FACTORY: COMMON CORE STATE STANDARDS

3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
3-LS4-4: Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.
4-PS3-4: Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

> HOUSEHOLD APPLIANCES

Appliance	Watts	Appliance	Watts	Appliance	Watts
Air Conditioner (Central)	5,000	Air Conditioner (Room)	1,100	Video Game Console	195
Clothes Dryer	3,400	Humidifier	300-1,000	Standard TV	188
Oven	3,000	Furnace Blower	300-1,000	Ceiling Fan	100
Hair Dryer	1,538	Vacum	500	Portable Fan	100
Coffee Maker	1,500	Water Heater	479	Water Pik	100
Dishwasher	1,200-1,500	Garbage Disposal	450	Tablet Computer	100
Microwave	500-1,500	Espresso Machine	360	Curling Iron	90
Portable Heater	1,500	Dehumidifier	350	Stereo	60
Refrigerator/Freezer	1,200-1,411	TV (Plasma)	339	Cable Box	20
Toaster Oven	1,200	Blender	300	Electric Shaver	15
Hot Plate	1,200	Desktop Computer	270	Clock Radio	7
Water Pump	480-1,200	Laptop	60-250	Telephone (Standard)	5
Iron	1,100	TV (LCD)	213	Cell Phone (Recharge)	2-4
Toaster	1,100	Electric Blanket	200	MP3 Player (Recharge)	.25-.40

> LIGHTBULBS

Bulb	Watts	Bulb	Watts	Bulb	Watts
100 Watt Incadescent	100	Compact Flurescent (100-Watt Equivalent)	30	40-Watt Halogen	40
75 Watt Incandescent	75	Compact Flurescent (75-Watt Equivalent)	20		
50 Watt Incadescent	50	Compact Flurescent (60-Watt Equivalent)	18		
30 Watt Incadescent	30	Compact Flurescent (40-Watt Equivalent)	11		

*The daily energy values lister are for the most efficient units in their class. Information was obtained from the Consumer Guide to Home and the General Electric website.

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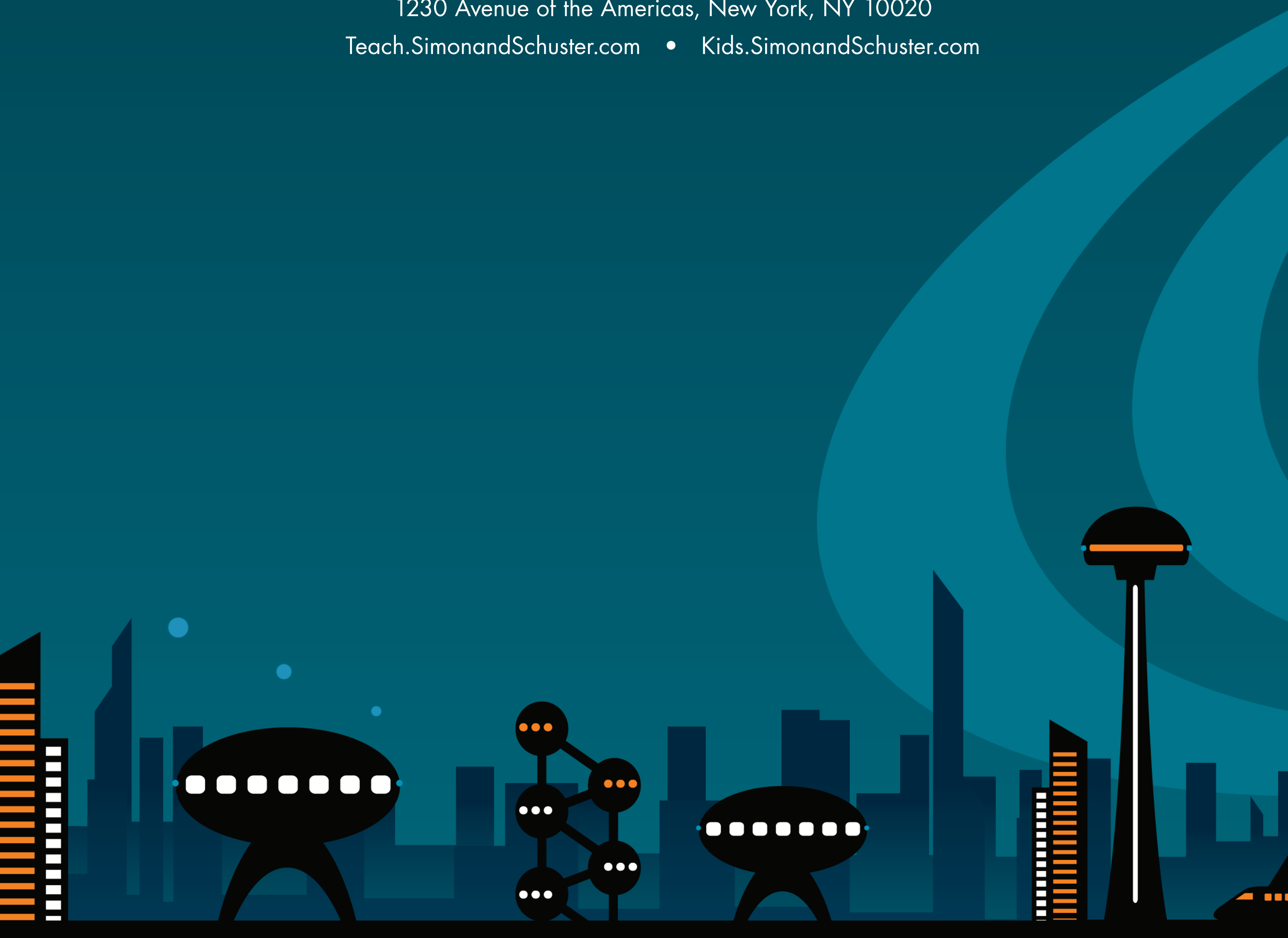

Guide written in 2015 by Stephen Heibel, a graduate student in education at Marylhurst University.
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