CONSERVATION STATION

WEEK OF RESOURCEFULNESS | CLASSROOM ACTIVITIES

ENERGY-WATER NEXUS STEM INVESTIGATIONS

Sustainable Cities & Communities (SDG 11)

KEY LEARNING OBJECTIVES

Students will be able to

- **Explore** how technology and sensors can maintain efficient use of resources.
- **Design** a smart city model that provides opportunities for all, with access to basic services, energy, housing, and transportation.

OVERVIEW

In this activity, students will work in a small group to explore and design a smart city. Students will research or brainstorm a list of ways that the Internet of Things (IoT) can be used to:

- Decrease the amount of energy and water used
- Promote inclusivity
- Address the digital divide
- Monitor traffic patterns
- Improve safety
- Manage waste
- Become more resilient to natural disaster

Teams will create an infographic summarizing their proposed solutions.

CONNECTION TO THE ENERGY-WATER NEXUS

- As the world population continues to grow, our resources are limited, and basic infrastructure will need to be created that efficiently carries critical supplies of water and energy.
- Our traditional thinking about water management is changing rapidly due to a growing population and dramatic variations in climate and precipitation patterns.

NATIONAL STANDARDS

Next Generation Science Standards

- **MS-ESS3-3 Earth and Human Impact**
  Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Itron | Discovery EDUCATION

Standards for Technological Literacy

- **Standard 4**
  Students will develop an understanding of the cultural, social, economic, and political effects of technology.
- **Standard 5**
  Students will develop an understanding of technology on the environment.

BACKGROUND

As the world continues to grow, we are facing a population that will reach nine billion within the next generation's lifetime. This growth is limiting our resources, and traditional urban growth models no longer meet our needs. Rapid urbanization is exerting pressure on fresh water supplies, sewage, the living environment, and public health. The transition to sustainable smart cities can help improve quality of life by meeting the needs of the present and ensuring future generations have the same access to the resources we have today. What makes a city smart? Generally, it requires intelligent IoT solutions that optimize infrastructure and government to better manage resources. In New York, hundreds of smart sensors placed in waste containers manage trash pickup by relaying information to disposal crews when the cans are full. In London, lampposts are being fitted with a collection of sensors and charging points for electric vehicles. The possibilities and innovations seem endless!

KEY VOCABULARY

- Internet of Things (IoT)
- Sustainability
- Infrastructure
- Limited Resources

MATERIALS

- Computer
- Internet Access

PROCEDURE

1. To open the lesson, introduce the students to the United Nations sustainable development goals. Share that more than 178 countries have adopted a comprehensive plan of action to build a global partnership for sustainable development to improve human lives and protect the environment. There are 17 major goals, and we are going to focus on goal 11, making cities inclusive, safe, resilient, and sustainable.

2. Share with the students that they are going to listen to some facts and figures the United Nations has shared about urbanization. Tell them that they are going to vote with their feet. If they think that the figure stated in bold is lower, they should walk to the left side of the room. If they believe the figure stated in bold is higher, they should walk to the right side of the room. Project the first statement on the board and read it loudly for everyone to hear. Invite students to consider if the figure in bold is higher or lower than

they believe and have them move to the right or left side of the room. Ask a few students to share why they selected that side of the room before sharing the correct answer. Continue this process with the rest of the statements.

a. Half of humanity lives in cities today and five billion people are projected to live in cities by **2050**. (lower–2030)

b. **725** million people live in slums today and most of them are found in Eastern and South-Eastern Asia. (higher–828 million)

c. The world's cities occupy just 3% of the Earth's land, but account for **40–50%** of energy consumption. (higher–60–80%)

d. Cities generate as much as **80%** of human-induced greenhouse gas emissions. (lower–70%)

e. By 2050, **60%** of the world population is predicted to live in urban settlements. (higher–70%)

3. Ask the class to describe the characteristics of a smart, sustainable city. Invite a student to capture the class ideas on the board.

4. Show the class the following video clip from CNBC Explains: What is a smart city?. After the video, have students compare some of the examples from the video with the ones they described as a class.

5. Challenge the class with developing their own model of a smart, sustainable city. Explain that they will work with a partner to create an infographic that summarizes how they will use IoT and smart devices to create their smart city.

6. Use the following link to show an example of an infographic. UN Goal 11: Make cities and human settlements inclusive

7. Distribute the Sustainable, Smart Cities Infographic and review the objective, directions, assignment criteria, and grading rubric. Links are provided on the student resource that will help the students with their research. The teacher can provide additional resources if necessary.

EXTENSION

1. Have students write to their government officials advocating for the kind of sustainable, smart city they believe they need.

2. Students can contact local utility companies to determine the types of IoT sensors the companies use to manage resources.

Sources

https://www.youtube.com/watch?v=bANfnYDTzxE
https://www.un.org/sustainabledevelopment/cities/
https://www.un.org/sustainabledevelopment/wp-content/uploads/2019/07/11_Why-It-Matters-2020.pdf
https://www.un.org/sustainabledevelopment/wp-content/uploads/2020/07/E_infographics_11.pdf
https://www.youtube.com/watch?v=Br5aJa6MkBc&t=2s

SUSTAINABLE, SMART CITIES INFOGRAPHIC STUDENT RESOURCE

Objective:

Today, you will develop an infographic on how the use of the Internet of Things (IoT) and smart devices can be used to create a sustainable, smart city.

Assignment Criteria:

1. Describe why sustainable, smart cities matter.
2. Briefly explain how the use of a smart device could improve the following areas of concern in urban environments:
    - Safety & security
    - Water management
    - Energy management
    - Waste management
    - Mobility
    - Access to food
3. Include at least three statistics to justify the use of the smart devices you selected.
4. Include pictures and images to help the reader understand.

How to Submit:

Use one of the following free infographic sites to select a template to modify and summarize your research.

- Canva—Free templates
- Piktochart: Create Infographics, Presentations and Reports

Possible Resources:

1. What is a smart city?
2. Sustainable Development Goals
3. Solutions—Smart Cities
4. Top 10 Growing Smart Cities

Rubric:

CATEGORY	3 Points	2 Points	1 Point
Why	The need for sustainable, smart cities was accurately described.	The need for sustainable, smart cities was described but was missing some details.	The need for sustainable, smart cities was poorly described.
Smart Devices	Devices were identified for all six areas and were concisely and accurately explained.	At least four devices were identified for four different areas and were concisely and accurately explained, or devices were identified for all six areas, but not explained concisely or accurately.	Less than four devices were identified for four different areas and were concisely and accurately explained.
Statistics	Three statistics were used to justify the use of the smart devices described.	Two statistics were used to justify the use of the smart devices described.	Fewer than two statistics were used to justify the use of the smart devices described.
Visuals	The images provided help the reader understand the topics.	The images provided help the reader understand some of the topics.	The images provided do not help the reader understand the topics.