

GREEN LABS: HOW SCIENTISTS CAN HELP FIGHT CLIMATE CHANGE

Julie Sesen, Stephanie Ragland, Valentina Lagomarsino and Sara Busatto*

Boston Children's Hospital, Harvard Medical School, Boston, MA, United States

YOUNG REVIEWERS:



THE
FUTURE
GREEN LAB
SCIENTISTS

AGES: 8–9

The healthcare industry creates 4.4% of the world's carbon emissions. To put this into perspective, if the healthcare industry were a country, it would be the fifth-largest carbon emitter on the planet. The goal of the healthcare industry is to create new, life-saving treatments for patients, but it also produces a lot of waste that cannot be recycled, such as plastic and chemicals. Additionally, this industry uses a lot of non-renewable energy. The Green Lab Project is a worldwide, 10-year-old program attempting to reduce the carbon emissions caused by the activities of scientists within the healthcare industry. The Green Lab project arrived at Boston Children's Hospital (BCH) in 2020, at the request of a group of postdocs, graduate students, and employees. The BCH Green Labs group is working to sponsor environment-protecting projects and educate BCH scientists to adopt more responsible, informed, and "greener" work practices. This article will describe ways that BCH scientists are trying to reduce lab waste and energy consumption, including sharing equipment and materials to limit waste production, cleaning freezers regularly, and using outlet timers to avoid wasting energy.

SINGLE-USE PLASTICS

Plastic items intended for single use only, after which they must be discarded.

CARBON EMISSIONS

The quantity of carbon-containing gases, often invisible, emitted by humans during their daily activities.

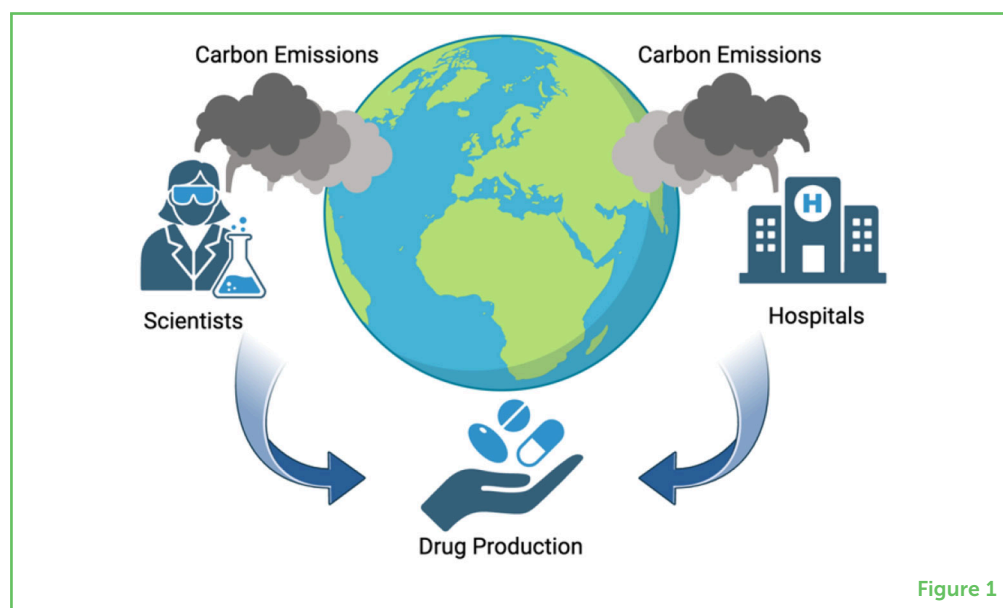
Figure 1

The worldwide healthcare system has a huge impact on the environment. Healthcare scientists and hospitals use a lot of single-use plastics and a ton of energy to perform experiments that will help them make new discoveries to help patients. These activities release carbon into the air, which is harmful to the planet. This figure was created with BioRender.com.

THE HEALTHCARE SYSTEM CAN IMPROVE TO BECOME MORE ENVIRONMENTALLY FRIENDLY

There are many types of scientists working in healthcare research laboratories all over the world. Some scientists study how tiny bacteria and viruses make us sick, and how to find the right cure. Other scientists study how the human body works, both when healthy and ill. Scientists also look at our genes and try to understand how certain genes result in certain diseases.

To perform their experiments, researchers must use many types of tools, pieces of equipment, chemicals, and **single-use plastics**. The equipment scientists use consumes a lot of energy, and the plastics that they throw away are not recyclable. The more energy and plastic an activity uses, more carbon is released into the environment. This means scientific work emits a lot of carbon (Figure 1)! Higher **carbon emissions** harm the planet and result in extreme events such as rising temperatures, melting polar ice, rising sea levels, and extreme weather events.



If the healthcare industry and its scientists were a country, they would rank fifth in carbon emissions, behind only China, the United States, India, and Russia. Laboratories and hospitals worldwide represent **4.4% of total carbon emissions** [1, 2]. Laboratories and hospitals use approximately five times as much energy as office spaces, and they generate **12 billion pounds of plastic per year**, which is equivalent to the weight of one million elephants [1, 2]!

BCH GREEN LABS—HELPING RESEARCHERS SAVE THE PLANET

Researchers are becoming aware of the need to make research more environmentally friendly. All over the world, scientists are trying to find innovative ways to be “greener”. Being greener means decreasing the environmental impact of their labs in terms of materials, water, energy, and waste production. Scientists can accomplish this goal with the help of numerous organizations. For instance, in the United States, we have two groups: *My Green Lab* and the *International Institute for Sustainable Laboratories* (I2SL). These two groups were founded to help researchers working in healthcare facilities learn how to be greener and reduce their **carbon footprint**.

At Boston Children’s Hospital (BCH), we created an organization called BCH Green Labs, which helps BCH researchers be greener both in their workspaces and at home [3]. This group is composed of volunteer postdocs, graduate students, and lab managers, and everyone is very passionate about the environment. BCH Green Labs has reached out to many teams within the hospital, to spread the word about reducing our carbon footprint. These teams include the Safety Department, which keeps scientists safe in the labs; the Facilities and Engineering Departments, which take care of all big equipment in the research buildings and ensure labs are always connected to the electrical system; and the Environmental Health & Safety Department, which manages trash pick-up and recycling. A lot of scientists are not aware of the impact they have on the environment or how to adopt **sustainable** practices. The goal of BCH Green Labs is to create awareness and share creative ideas with everyone (Figure 2).

CARBON FOOTPRINT

The measure of the amount of carbon emissions resulting from human daily activities and its impact on the global environment.

SUSTAINABLE

A human activity that efficiently uses energy and water while minimizing waste. Sustainable processes aim to meet the needs of all while managing the earth’s resources.

Figure 2

Communication and partnership are key to sustainable science. **(A)** BCH Green Labs teams up with the hospital managers in safety, engineering, and operations to share ideas. **(B)** BCH Green Labs educates and communicates with scientists to provide new ways to **(C)** reduce, reuse and recycle in the labs. Scientists apply what they have learned so that together, they can make science a greener environment. This figure was created with [BioRender.com](https://www.biorender.com).

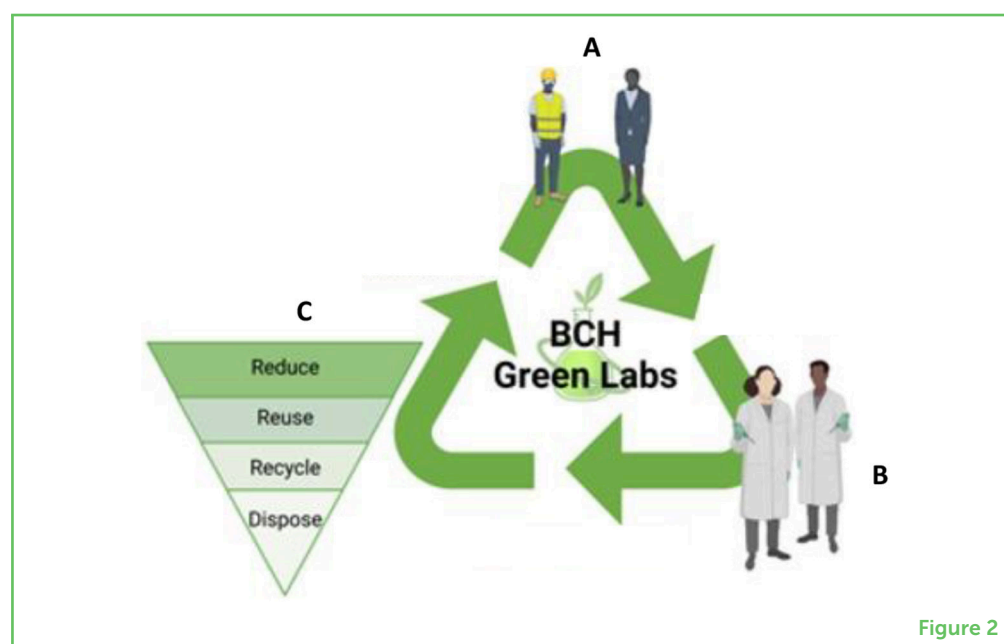


Figure 2

WHAT ARE BCH SCIENTISTS DOING TO BE GREENER?

Based on the discussions that BCH Green Labs had with the various hospital teams, here are some of the creative ways we have been trying to reduce BCH's carbon footprint.

- **The Freezer Challenge.** Every year, BCH labs defrost and clean their big freezers, to reduce energy use and save time and money. At the same time, this initiative helps people develop good cold-storage practices that will hopefully become standard practice in the lab and be taught to future lab members. Did you know that most lab freezers are kept at -80°C (four times colder than the freezer you have at home)? But they do not have to be! Increasing a freezer's temperature by just a few degrees (from -80 to -70°C) saves up to 30% of energy—this is about the amount of energy needed to power one home for a whole year! Crazy right? Importantly, a change of just 10°C has little impact on the quality of the biological samples (urine, saliva, blood, etc.) being kept in the freezer, but this change can positively impact the environment!

Achievements so far: In 2022, BCH won the *Top Clinical Organization Award* of the International Freezer Challenge, organized by My Green Lab and I2SL, saving 463.8 kWh/day of energy, the equivalent of 16 households worth of energy saved daily.

- **Share equipment, chemicals, and supplies.** To reduce waste and save space, energy, and money, BCH labs decided to share instruments and materials instead of each lab buying their own. This simple practice helps reduce not only waste and energy consumption but also the number of shipments to BCH and the use of packaging material (e.g., non-recyclable plastic such as bubble wrap, ice packs, Styrofoam coolers, etc.).

Achievements so far: BCH Green Labs created a chemical inventory, to promote sharing of common chemicals among all BCH laboratories, significantly reducing waste.

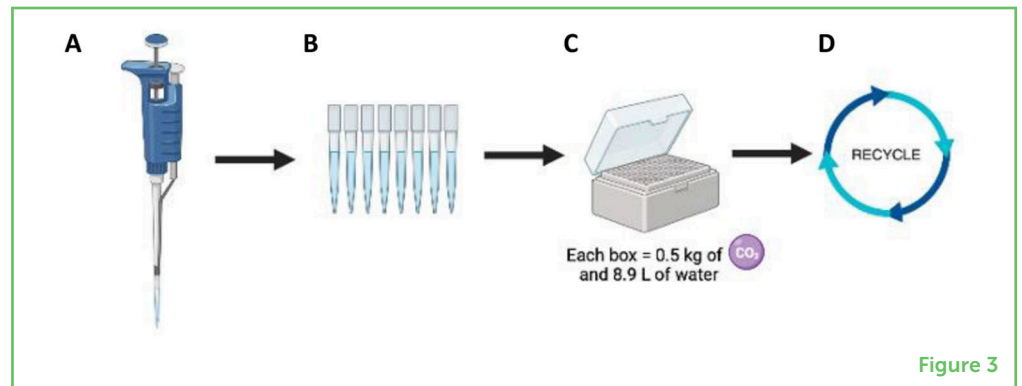
- **Purchase sustainable lab products when possible:** Over the years, an increasing number of sellers have begun to offer products that are manufactured using less plastic and energy. Some companies have adjusted their shipping methods to minimize their impact, by replacing Styrofoam containers with cardboard boxes and using less plastic.

Achievements so far: Scientists often use plastic pipette tips to transfer minuscule amounts of liquids between containers. These tips are

made of plastic and are non-reusable. However, the boxes they come in can be reused and refilled with new pipette tips. To reduce waste, BCH labs have begun reusing and refilling these boxes (Figure 3).

Figure 3

Example of how plastic boxes can be recycled in a green lab. **(A)** Scientists frequently use instruments called pipettes to dispense tiny volumes of liquids needed in experiments. **(B)** The pipette uses a disposable plastic tip. Every day in the lab, scientists use and throw away many pipette tips. **(C)** Pipette tips come in plastic boxes. **(D)** Thanks to the Green Labs initiative, the plastic boxes can now be recycled. This figure was created with [BioRender.com](https://www.biorender.com).



- Use “turn off” signs and outlet timers. It is important for lab workers to remember to turn off lights and pieces of equipment that are not needed overnight. For this reason, we printed, distributed, and posted signs and posters to remind researchers to turn off computers, lights, and other instruments. Furthermore, to avoid having to turn things off manually, we introduced the use of outlet timers that turn equipment off and on automatically at specific times.

Achievement so far: Two research buildings have adopted our turn-off signs to help with energy savings.

- Events for outreach and education of BCH employees. We hold monthly seminars for BCH scientists, where they can learn about the ongoing initiatives and about ways to reduce and reuse lab materials.

Achievements so far: We have organized two outreach events, with an average of 40 attendants each. We have over 150 scientists subscribed to our newsletter.

CONCLUSIONS

As the healthcare industry has a significant impact on the global environment, it is essential for all scientists to work toward reducing healthcare’s carbon footprint. BCH is among the first hospitals in the Boston area to implement a Green Lab initiative aimed at reducing, reusing, recycling, and responsibly disposing of medical waste. Green Lab initiatives worldwide could significantly help in the fight against climate change, by educating scientists and changing their behaviors in ways that would hopefully carry over to future generations.

This article is another way to spread the word among future scientists, to help them to be more conscious of how they choose to buy, use, and dispose of materials for their experiments—and in their daily lives. We invite you to be mindful of when you can reduce (e.g., not buy something that you will throw away after one use), reuse (e.g., share with your friends), and recycle (e.g., dispose of waste in the right bin). We have made a lot of progress in our hospital, by seeing where the problems are and taking baby steps to turn them into greener practices. There is still a long way to go, and we need your help to make this planet greener! Are you ready to change the world without leaving a (carbon) footprint?

REFERENCES

1. Evans, A. M. 2021. Sustainable healthcare - time for 'Green Podiatry'. *J. Foot. Ankle. Res.* 14:45. doi: 10.1186/s13047-021-00483-7
2. Rodriguez-Jimenez, L., Romero-Martin, M., Spruell, T., Steley, Z., and Gomez-Salgado, J. 2023. The carbon footprint of healthcare settings: a systematic review. *J. Adv. Nurs.* 79:2830–44. doi: 10.1111/jan.15671
3. Dolgin, E. 2018. How going green can raise cash for your lab. *Nature* 554:265–7. doi: 10.1038/d41586-018-01601-5

SUBMITTED: 06 August 2023; **ACCEPTED:** 19 December 2023;

PUBLISHED ONLINE: 19 January 2024.

EDITOR: [Andrea Quintero](#), Boston Children's Hospital and Harvard Medical School, United States

SCIENCE MENTORS: [Stefanie Perrier](#)

CITATION: Sesen J, Ragland S, Lagomarsino V and Busatto S (2024) Green Labs: How Scientists Can Help Fight Climate Change. *Front. Young Minds* 11:1273603. doi: 10.3389/frym.2023.1273603

CONFLICT OF INTEREST: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

COPYRIGHT © 2024 Sesen, Ragland, Lagomarsino and Busatto. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](#). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

YOUNG REVIEWERS



THE FUTURE GREEN LAB SCIENTISTS, AGES: 8–9

Our Young Reviewer group name is: The Future Green Lab Scientists! We are between 8 and 9 years old and very interested in science. Haven participated in this year's science fair with a project on how to make boba, and Jason did an experiment in science class involving growing a magic crystal tree. Andrew thinks it is neat we can see pictures of brains, and Yichen and Temi both love learning about science. Our group slogan is: we are the earth dream team!

AUTHORS

JULIE SESEN



Julie Sesen was a postdoctoral research fellow in the Vascular Biology Program at Boston Children's Hospital (BCH) for 6 years; she is now a research scientist at Vertex Pharmaceuticals. Before coming to Boston, Julie got her Ph.D. in oncology at the Cancer Research Center of Toulouse in France, at the end of 2016. Julie was also involved in the BCH Postdoc Association, as treasurer and chair of the public affairs committee. In 2020, when the pandemic hit, Julie decided to take action for the environment and educate herself about Green Labs. After becoming an ambassador for the non-profit organization My Green Lab, Julie got her lab certified with the highest level from My Green Lab; this was just the beginning of the story. With Stephanie Ragland, Julie started BCH Green Labs in December 2020.

STEPHANIE RAGLAND



Stephanie Ragland received her Ph.D. in 2018 from the University of Virginia, where she studied how bacteria avoid being killed by the immune system. She is currently working as a postdoctoral research fellow at Boston Children's Hospital, where she studies how the immune system detects bacteria. Dr. Ragland joined BCH Green Labs in 2020.

VALENTINA LAGOMARSINO



Valen is a sixth-year Ph.D. candidate in the Biological Biomedical Sciences program at Harvard Medical School. She is working on her thesis in the lab of Dr. Meenakshi Rao at Boston Children's Hospital (BCH), studying how bacteria living in our guts can alter host hormone levels to regulate bowel function. She is passionate about understanding our symbiotic relationship with microbes and all living things on the planet. Valen would love to make science more environmentally sustainable! She is a member of BCH Green Labs, where she advocates for greener policies within the hospital. She is also a member of Harvard's Council for Student Sustainability Leaders, where she is trying to make all labs in the Longwood Medical Area more environmentally conscious.

SARA BUSATTO



Sara Busatto received her Ph.D. in 2019 from the University of Brescia, Brescia, Italy, where she studied tiny cell-secreted particles known as extracellular vesicles. She is currently working as a postdoctoral research fellow in the Vascular Biology Program at Boston Children's Hospital and Harvard Medical School, where she

studies how cancer cells spread to the brain. Dr. Busatto joined BCH Green Labs in 2021. *sara.busatto@childrens.harvard.edu