Please feel free to change the wording and spice up the lectures to communicate naturally with your participants. It is best for educators to have read the lectures fully to be well prepared for any questions the participants may have.

**Welcome and Introduction**

**Instructor:** "Good [morning/afternoon], everyone! Welcome to our workshop on clean water science. Today we're going to dive into the fascinating world of water purification. We will explore how we can clean and reuse dirty water, focusing specifically on carbon filtration. This is an exciting topic that shows us the incredible ways we can care for and enjoy one of our most precious resources: water.

Before we get started with our experiments, I want to give you a brief introduction to the beauty and utility of clean water and the various methods used to purify it. Understanding these basics will help you appreciate the science behind the experiments we'll be conducting.

**The Beauty and Utility of Water**

Water is truly amazing. It's everywhere around us, from the rain that waters our plants to the oceans that cover most of our planet. Water is essential for all forms of life. It's in the food we eat, the air we breathe, and every cell of our bodies. Without water, we couldn't grow our favorite fruits and vegetables, enjoy refreshing swims in the summer, or even have a nice warm cup of tea.

Clean water is not only vital for our health but also adds joy and beauty to our lives. Think about the fun of splashing in a pool, the calm of a quiet lake, or the thrill of exploring underwater life. Water brings communities together, supports countless activities, and inspires creativity in art, music, and literature.

**Overview of Water Purification Methods**

To keep enjoying these wonderful benefits, we need to make sure our water is clean and safe. There are several methods used to purify water, each with its own advantages and applications. Here are a few common methods:

1. **Boiling**: This simple method kills most types of harmful organisms but doesn't remove chemical contaminants.
2. **Filtration**: Uses physical barriers to remove impurities. This includes sand filters, ceramic filters, and more advanced membrane filters.
3. **Chlorination**: Adding chlorine to water can kill bacteria and viruses. It's widely used in municipal water treatment but can leave an unpleasant taste and smell.
4. **Distillation**: Involves boiling water and then condensing the steam back into liquid. It's effective but energy-intensive.
5. **Reverse Osmosis**: Uses a semi-permeable membrane to remove ions, molecules, and larger particles from drinking water. It's highly effective but can be costly.

Each of these methods plays a role in ensuring we have access to clean, beautiful water. Today, we'll focus on one specific method: carbon filtration.

**Brief Introduction to Carbon Filtration**

Carbon filtration uses activated carbon to remove contaminants from water. Activated carbon is a special form of carbon that has been treated to have lots of tiny holes or pores, making it highly effective at trapping impurities.

When contaminated water passes through the activated carbon, the contaminants stick to the surface of the carbon particles. This method is particularly good at removing organic compounds, chlorine, and other chemicals that can affect the taste and safety of water.

In our experiments today, we'll build and test our own carbon filtration systems using the 4M Clean Water Science Kit. This kit includes everything we need to understand how carbon filtration works and see it in action.

By the end of this workshop, you'll not only understand the science behind carbon filtration but also appreciate the role it plays in keeping our water clean and beautiful. So, let's get started and explore the fascinating world of water purification!"

**Instructor:** "Does anyone have any questions before we move on to our first experiment? Great, let's dive in!"

# How Activated Carbon Absorbs Contaminants

## Introduction to Carbon and Filtration

**Instructor:** "Hello, everyone! Before we start our experiments, I want to explain two important things: carbon and filtration. These are key to understanding what we're doing today.

**What is Carbon?** First, let's talk about carbon. Carbon is a very common element. It's a building block of life and is found in all living things. You might not see it, but carbon is everywhere. For example, when you draw with a pencil, the 'lead' is actually made of a form of carbon called graphite.

Now, activated carbon, which we will use today, is a special form of carbon. It has been treated to have lots of tiny holes or pores. These pores give it a huge surface area, which helps it trap tiny particles and impurities from water.

**What is Filtration?** Next, let's talk about filtration. Filtration is a process used to clean things by removing unwanted parts. Imagine you're making lemonade and you want to remove the lemon seeds. You might use a strainer. The strainer lets the liquid pass through but catches the seeds. This is a simple form of filtration.

In our experiments, we're going to filter dirty water to make it clean. We'll use activated carbon to catch the tiny impurities in the water, similar to how the strainer catches lemon seeds. The clean water will pass through, leaving the impurities behind.

**Why is This Important?** Clean water is very important for our health and the environment. By understanding how carbon and filtration work together, we can see one way to help make sure our water is safe to drink.

Today, we'll build our own filter systems using activated carbon. We'll see how this material can trap contaminants and help purify water. It's a cool science experiment that also shows us how we can solve real-world problems.

Any questions before we get started? Great, let's dive into our experiments and learn more about the science of clean water!"

## How Does Activated Carbon Work?

Activated carbon works through a process called adsorption. Now, adsorption is different from absorption, so let's look at what that means.

**What is Adsorption?** Adsorption is when contaminants stick to the surface of the activated carbon. It's like how sticky tape catches dust. The dirt and impurities in the water get trapped on the carbon's surface, making the water cleaner.

**Why is Activated Carbon So Good at This?** Activated carbon has tons of tiny holes, or pores, inside it. These pores create a huge surface area where contaminants can stick. Imagine if activated carbon was a sponge with millions of tiny holes soaking up the impurities in the water.

**Types of Adsorption:**

1. **Physical Adsorption:** This involves weak forces called van der Waals forces. Think of it like a magnet that can hold on to larger molecules and impurities.
2. **Chemical Adsorption (Chemisorption):** This involves stronger chemical bonds. It's like glue that catches specific contaminants really well.

In our experiments today, we'll see how activated carbon uses both types of adsorption to clean water. We'll build our own water filters and watch as the dirty water becomes clean. It's an amazing process that shows how powerful science can be in solving everyday problems.

## Types of Contaminants Removed by Activated Carbon

**Instructor:** "Alright, everyone! Now that we know how activated carbon works, let's talk about the different types of contaminants it can remove from water. This will help us understand why it's so effective and important.

**Organic Compounds:** Activated carbon can remove things like pesticides and herbicides. These are chemicals used in farming to protect crops but can end up in our water. It also removes other volatile organic compounds, or VOCs, which are harmful chemicals that can be found in polluted water.

**Chlorine and Chloramines:** In many cities, chlorine and chloramines are added to tap water to kill bacteria and make it safe to drink. However, these chemicals can make the water taste and smell bad. Activated carbon can remove them, improving the taste and smell of our water.

**Tannins and Phenols:** These substances can make water look yellow or brown and give it an unpleasant taste and odor. Tannins come from natural sources like leaves and tree bark, while phenols are often from industrial pollution. Activated carbon helps to clean these out of the water.

**Pharmaceuticals and Personal Care Products:** Recently, we've found that tiny amounts of medicines and products like shampoo and soap can end up in our water. These are called emerging contaminants because we're only just starting to understand their impact. Activated carbon can help remove these substances, making our water safer to drink.

## Visual Aids and Additional Resources

- **Diagrams**: Show diagrams of the pore structure of activated carbon and the adsorption process.
- **Videos**: Include short video clips demonstrating real-world applications of activated carbon.

By understanding the science behind how activated carbon works, participants can appreciate its role in water purification and other environmental applications. This lecture aims to provide a comprehensive overview of the adsorption process and the benefits of using activated carbon.

4M Clean Water Science Youtube Walkthrough