# Carbons for water treatment: Discussion Activity

## Discussion

In the experiment you used a porous carbon to remove fragrance molecules from water. The carbon is called *porous* because it has lots of little holes (pores) going through it.

When a material has lots of pores, it has a higher surface area.

When the carbon removes the pollutant molecules from water, the pollutant molecules stick to the surface of the carbon. This happens through interactions between the pollutant molecule (normally an organic molecule) and bonds on the surface of the carbon.

If your carbon has a high surface area, there is more space for pollutant molecules to stick to.

## Icon Description automatically generatedFeeling porosity activity

Print out the shapes using swell paper or cut them out of cardboard and glue them to a piece of card or paper.

There are three shapes. The top shape represents a piece of carbon that has no pores. Run your finger around the edge.

The second shape has some pores. The third shape has lots of pores. By running your finger around the edge can you determine which of the three shapes has the highest surface area?

*Materials that have lots of small pores have the highest surface area. This can be hundreds of square metres per gram of material! A high surface area is good if you want to remove lots of pollutants from water.*

## A chemist’s perspective

Porous carbons are interesting because they can be made from natural materials like wood or nut shells. Many of these already contain some pores, although these are quite large. If we heat wood to a high temperature in a furnace without air, we can turn it into carbon.

There are also some clever ways that we can treat the carbons to get even more pores. This can include ‘burning’ extra pores into the carbon using steam or chemical compounds. This process is called *activation*. It is what is used to make activated carbons.

## Advanced Questions

How do the fragrance molecules ‘stick’ to the carbon surface?

*This occurs through intermolecular bonds between the fragrance molecule and the surface of the carbon. The carbon atoms on the surface of the porous carbon are likely to have lots of bonds to things like OH groups. These are called ‘dangling bonds’ since they ‘dangle’ from the surface of the carbon! You can treat some solid materials with different chemicals to change the ‘dangling bonds’.*

Do you think the chemistry of the porous material matters?

*The ‘dangling bonds’ will change depending on the material and how it’s been treated. For example, treating a porous carbon with something like sodium hydroxide is likely to put lots of polar groups like OH on the surface. For a pollutant to stick to the carbon, you need good intermolecular interactions so the chemistry at the surface of the porous material is really important.*

Do you think the size of the pore matters?

*Absolutely! Smaller pores mean a higher surface area. But if the pores are too small then it’s hard for fluid to flow along them. The best materials probably have different sizes of pores to balance fluid flow and surface area.*

What might be a problem with the ‘filled’ porous material *i.e.* the carbon material once it’s been used to remove lots of pollutants from water?

*Disposal of such materials can present a big challenge. If you’re using your material to clean up radioactive waste, for example, you then need to think of a safe way to dispose of it.*