Climate chemistry for Kindergarten

blockplay.ai

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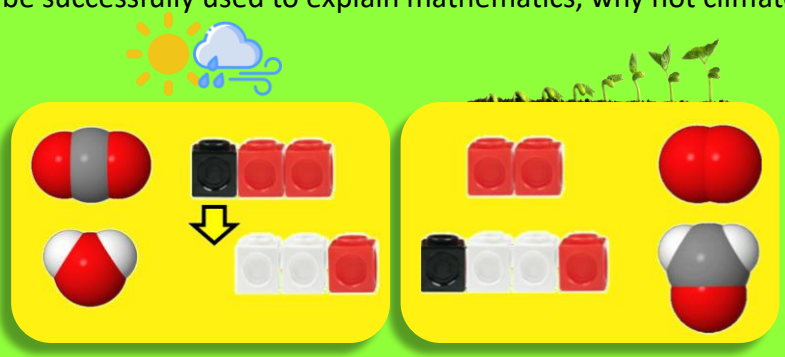
The challenge

The IPCC target of reducing net CO_2 emissions to zero by 2050 to avoid runaway global warming is expressed in chemical terms. Yet according to the RSC's recent *Green Shoots* report, few children, parents or primary school teachers have the carbon literacy to understand what 'CO_2' is or where it comes from. This makes it challenging for chemists to communicate with children and their parents and teachers about the rapidly evolving science of climate change that is likely to drastically affect their lives as they grow up.

Chemistry as block play

Blockplay.ai is inspired by the global popularity of block play – *Lego* is now the world's biggest toymaker, and *Minecraft* the most popular video game. And in particular by the success of the BBC's CBeebies *Numberblocks* series – whose YouTube channel now has almost 8 million subscribers – which uses blocks to explain mathematics to pre-schoolers. If block play can be successfully used to explain mathematics, why not climate chemistry?

Left: the app detects 2 white blocks and 1 red together, and displays a spinning H_2O molecule. **Right:** Modelling a simplified carbohydrate molecule with Cuisenaire rods



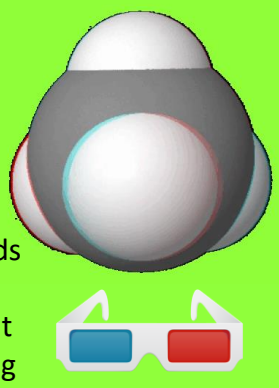
Photosynthesis as block play: starting with block models of CO_2 and water (left), the carbon block can be pulled off the CO_2 and attached to the water molecule to show how it is 'captured' in plants, in a simplified model of a carbohydrate (right).

Scan this QR to see a 1-minute clip of the app in action

The blockplay.ai project imagines that young children can understand basic carbon chemistry before they can read, count, or use a mouse. By turning the building blocks young children already enjoy playing with into a haptic interface for 3D atomic visualisation software, black, red and white interlocking cubes become atoms of Carbon, Oxygen and Hydrogen which they can physically connect together and pull apart to make molecules such as water, oxygen and CO_2, and enact simple reactions such as combustion, respiration and photosynthesis, brought to life in child-friendly animations.

The blockplay.ai app

In partnership with children at a local school and a software developer, we developed an app that uses AI object recognition to marry children's block play with 3D molecular visualisation software. The free-to-download prototype app runs on a standard Windows laptop connected to a webcam pointed at a tabletop where children place blocks. When they take their hands away the app's YOLO AI algorithm processes a snapshot of the blocks and displays the relevant animated 3D molecules in near real time, narrating what is being shown. Currently the app's AI is trained to recognise both interlocking cubes - common in primary schools and early years settings - and Cuisenaire rods, which are distinguishable by length and colour, and so more accessible to visually-impaired users, who may use the app screenlessly via audio.



The app features modes to see molecules spinning in 3D using red/cyan glasses (left), and a 'Dance Atomic' mode to encourage enacting reactions as dances (right)

Planned next steps are to trial more widely with children, parents and teachers to inform new phases of development, including porting to mobile phones, and with chemistry consultants to extend to more complex molecules for potential use in secondary schools and universities. For further information, and details of how to download the app, or join the trial, see **https://blockplay.ai** or scan this QR:

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