

# THEORETICAL CHEMISTRY WITH PROF MARK TUCKERMAN

## TALKING POINTS

- 1) How does a fuel cell deliver power? (See *What are electrochemical fuel cells?*)
- 2) Which two “waste products” are produced when hydrogen fuel is used in a fuel cell? (See *What are electrochemical fuel cells?*)
- 3) What does an anion-exchange fuel cell consist of? (See *How do anion exchange fuel cells work?*)
- 4) Which precious metal has proved to be an effective catalyst for redox reactions and why? (See *What is the advantage of the anion exchange membrane fuel cell over other electrochemical fuel cells?*)
- 5) What can fuel cells be used to power? (See *What are electrochemical fuel cells?*)
- 6) How does a fuel cell convert the chemical energy of the fuel into electricity? (See *What is the advantage of the anion exchange membrane fuel cell over other electrochemical fuel cells?*)
- 7) How do the efficiencies of fuel cells to power vehicles compare with petrol-powered engines? (See *What are electrochemical fuel cells?*)
- 8) What are the advantages of theoretical chemistry? (See *What benefits does theoretical chemistry bring to society?*)

## ACTIVITIES YOU CAN DO AT HOME OR IN THE CLASSROOM

Mark believes it will be highly beneficial for any budding theoretical chemists to learn one or more programming languages. He recommends becoming well-versed in Python. With that in mind:

1. Take a look at [www.learnpython.org](http://www.learnpython.org) and try to get a feel for that particular programming language.
2. There are many opportunities to learn the basics in Python, beginning with a chapter entitled Hello, World!. Have a go at the tutorial and see whether it is something that appeals to you.
3. Once you have got to grips with the tutorials, there is an interactive course created by DataCamp, which you can start for free. It will help you learn the basics of data analysis in Python, which should stand you in good stead for your future career!

### MAKE A POTATO CLOCK!

To work, an anion-exchange fuel cell needs an ion-conducting material known as an electrolyte (see *How do anion fuel cells work?*). Did you know that the mild phosphoric acid in potatoes can act as an electrolyte to power a small clock? To make a potato clock, you need:

- Two potatoes (marked 1 and 2)
- Three pieces of copper wire
- Two galvanised nails (coated in zinc)
- Three alligator clips
- A small digital clock (with the 1-2-volt battery taken out)

Put one nail and a piece of copper wire into the opposite ends of potato 1. Do the same with the potato 2. Using an alligator clip, connect the copper wire from potato 1 to the positive (+) terminal in the clock (where the battery should be). Using another alligator clip, connect the nail in potato 2 to the negative (-) terminal in the clock with the loose copper wire. Now connect the wire in potato 2 to the nail in potato 1. Make sure all the connections are tight. You should see the digital clock turn on!

To find out how a potato clock works, check out:  
<https://www.real-world-physics-problems.com/potato-clock.html>

Now try this experiment with a lemon or a cup of salty water. What happens?