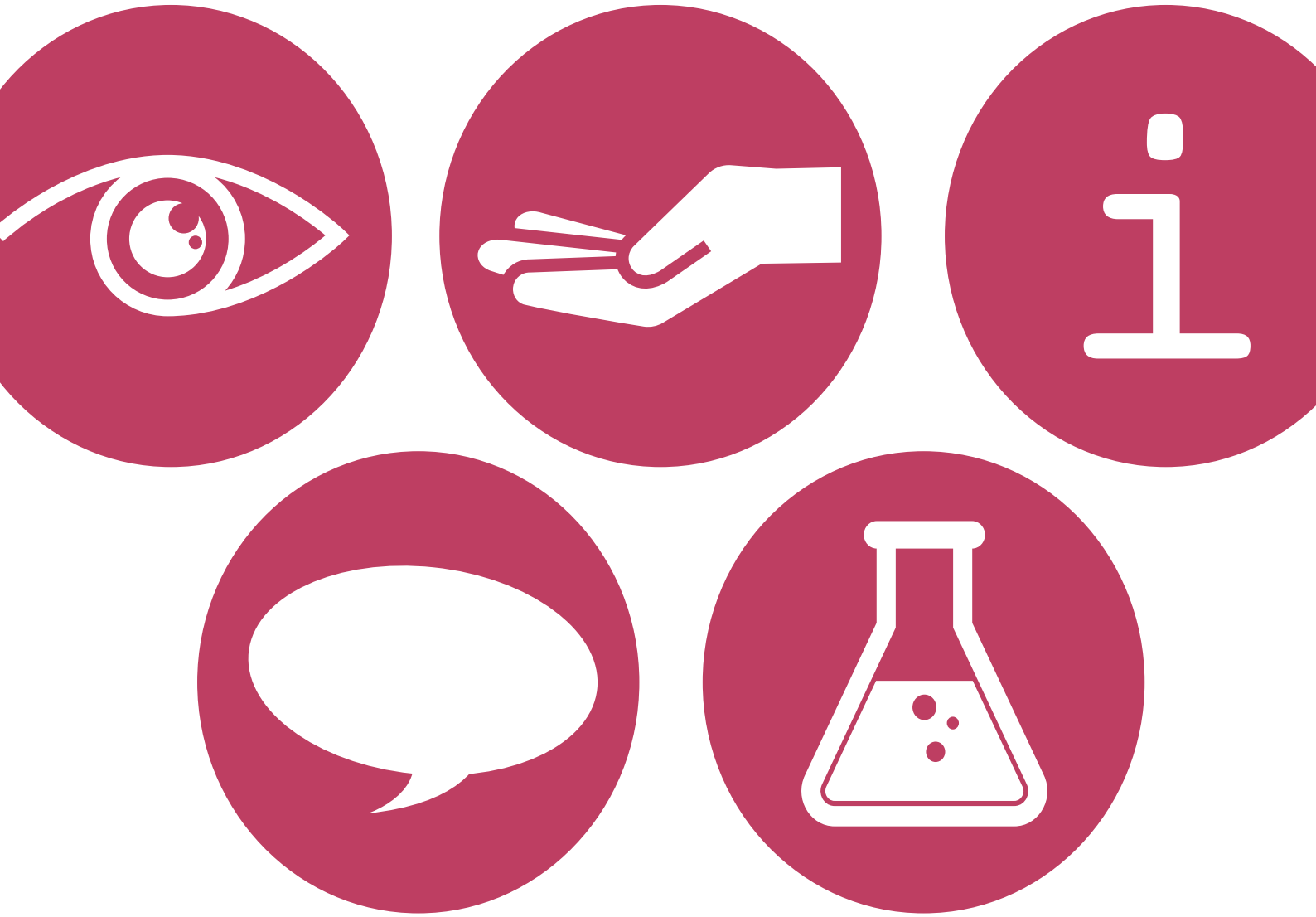
The Royal College of Pathologists
Pathology: the science behind the cure



URINE TROUBLE
RESOURCE PACK

Learning Objectives

- Learning about excretion, kidney function, diabetes, osmoregulation, digestion and nutrition;
- Understanding why urine is so important, and the analysis of urine in diagnosing diseases;
- Learning to question and discuss issues that may affect their own lives, the directions of societies and the future of the world.

Materials Required

- A set of test tubes in a rack, filled with different coloured water (see below for colour mixing).
- Small packets of powdered, safe, food colouring of the different colours.
- A few drops of milk.
- Access to water.
- Lemon juice (optional).
- A plastic jar (optional).
- Clinistix (optional).
- Several Petri dishes (depending on the number of scents available).
- Possible scents (e.g. mouthwash, rose essence, coconut oil).
- Cotton wool/make up remover pads.
- Permanent marker pen.
- Coffee beans in a small container (optional).
- Pipettes (for adding drops of scents to cotton wool pads; optional).
- Powerpoint slides for projection:

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Making up the colours:

- Dark Yellow – food colouring
- Pale Yellow – add more water to the darker yellow food colouring (more dilute)
- Clear – water with a dash of lemon juice
- Green – food colouring
- Pink – food colouring
- Red – food colouring
- Milky/Cloudy – water with a dash of milk
- Other options: If you want to have other colours available, you can use blue, purple, brown and black food colourings, however the above 7 are sufficient, especially if running the activity with KS2.

Making up the 'sniff tests':

- Into each Petri dish add a cotton wool pad. (A set of Petri dishes can be provided per group, or per class and the samples swapped around).
- Onto each pad add a few drops of the scent (or take off a top layer of the cotton pad and add a few drops to the middle and sandwich the top layer back on).
- Label the Petri dishes depending on the number of samples (with permanent marker pen, on the lid and on the bottom): 'A', 'B', 'C'...
- Set up and label another couple of Petri dishes in the same way (labelled '1' and '2') and use a few drops of water in both, or into one of the samples add a very small drop of diluted lemon juice (or any other 'scent' of choice).

Health and safety

Find out if any students have allergies, as there may be allergens present in the food colouring. Make sure these students do not handle or ingest the samples (unless required to e.g. clear sugar solution as pretend 'diabetic urine' at KS3) and if they do need to handle any samples, to wear non-latex gloves.

Time taken

45 min – 1 hour

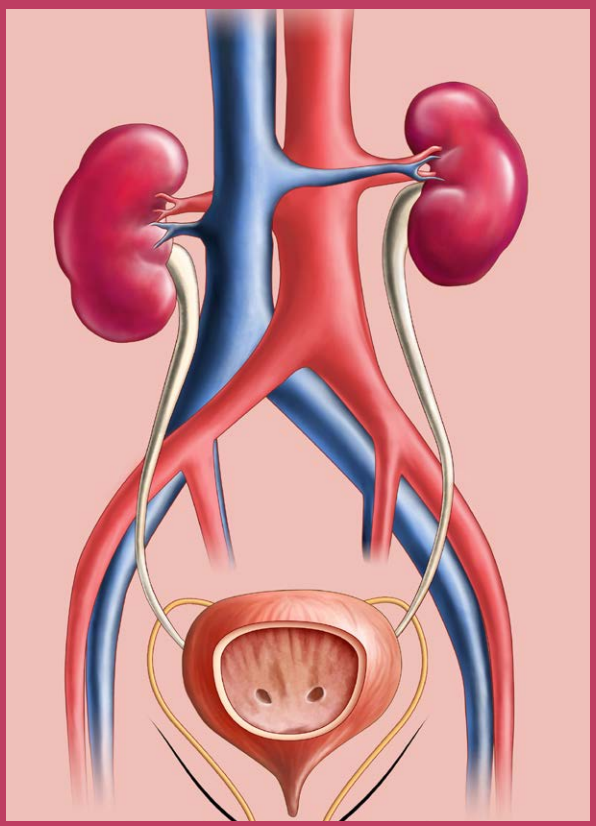
Practical

Set up the room so that students can sit in groups. Depending on the ages of the groups, you can use sheets of paper/flipchart for students to note down what they think each sample is throughout the activities. With younger groups it is easier to choose students from each group to call out, or ask students to put their hands up and give you their answer(s).

Introduce yourself (if a pathologist) and what pathology is all about. As a teacher, you may wish to mention how chemical pathologists/clinical biochemists analyse chemicals/biochemical substances in the body, such as salts, proteins, fats, carbohydrates and metals, to find out what's wrong with us when we give a sample to our doctor. Pathology is a special part of medicine. (Anything with 'ology' is a branch of study – a part of a subject, 'a study of').

Start by showing either a slide, or a jar of 'pretend' urine (water dyed light yellow). Ask everyone what they think it is. Discuss 'wee' and what else we might call it (pee, spending a penny, taking a leak), and how we call it 'urine' in science.

Then look at excretion. What is it? Why do we need to wee? Where are our kidneys (anatomical diagram)? Any extra fluid in our bodies that we don't need and any waste (salts, hormones, minerals) is excreted through our kidneys. As 95% of our urine is water, if we don't drink enough water, our urine looks yellow (because of the pigment urobilin). It can be a darker yellow depending on how dehydrated we are.



The urinary system produces and stores urine (fluid waste) from our body. The kidneys, which sit just below the rib-cage towards your back, help regulate the balance of chemicals and water in the body. The kidneys filter waste (such as urea, a by-product of protein breakdown, salts, hormones and minerals) and excess water from the blood. The urine travels from the kidneys, through the ureters into the bladder. The bladder stores the urine. Once the bladder is full (a normal bladder can hold almost half a litre comfortably for a few hours), it can be emptied through the urethra. Healthy adults produce around 800-2000 ml of urine a day.

Ye Olden Times...

Historically, medical professionals would hold up samples of urine to the light and compare the urine to a chart to see what the colour meant, (what disease/condition the colour corresponded to) or they would simply guess what was wrong with the patient. Ask what else they think these medics may have done to analyse the urine samples? Tasted them, perhaps?

The easiest, safest preliminary test you could do, and still can do is: using your sight... the power of observation.

Show students the Planet SciCast video: A Wee Bit Of Science. We may be familiar with urine of those shades of yellow, pale yellow or clear. But what does it mean when urine looks like another colour of the rainbow?

Show students a set up with tubes of possible urine colours. They can pass them around (provided they are sealed or with lids). It seems there might be a lot we can tell from the colours of our urine samples. (See 'Colours' sheet below).

Powerpoint Slides:

Click through each slide. What do the students think about this diagnosis? It's actually the worst case scenario for that particular colour of urine. Click to the next slide to see the more non-life threatening scenario. What do the students think? Have a look at each colour in turn. This is why further tests need to be done, and doctors need to take a history i.e. ask a patient what they have been doing recently.

Using our other senses: Diabetic urine tastes sweet. Ask the students if they fancy tasting some wee? Probably not. Explain to them that there are many new sophisticated tests available for testing exactly what the glucose levels are in urine, what they are in blood and also interestingly, we can detect signs of cancer from studying our wee! One test for prostate cancer, involves sniffing. Tell them that we are going to see how good their noses are.

Give students the scented Petri dishes, asking them to try and identify each smell after opening the dish and having a sniff (then closing it and passing it on). They can either write down what they think each sample is, or call it out at the end, and have a vote system: 'Hands up those of you who agree that Sample A was X?'

Students can use the back of their hand or sniff some coffee beans to help re-set their nasal palette (olfactory habituation).

Ask them then to differentiate between Samples 1 and 2 – is there a difference and what is the difference?

Finally, explain that the whole sniffing exercise is not to do with how good OUR noses are for diagnosis. (You will find that most of them couldn't work out what some smells were). This is about Medical Detection Dogs and how good a dog's nose is. Show a picture of a medical detection dog, and explain that during tumour growth, if there is a production of volatile organic compounds excreted in the urine, these can be picked up by the dogs. Do they think human noses would be any good at detecting the difference?

Useful Links

The urine colour wheel:

http://blogs.scientificamerican.com/oscillator/the-urine-wheel/

Medical Detection Dogs:

http://medicaldetectiondogs.org.uk

Planet Science's A Wee Bit of Science video:

http://scicast.org.uk/films/2011/06/a-wee-bit-of-science-1.html