# Sniffing out disease lesson

## Years 9 and 10

In this lesson, students consider contemporary research approaches to disease identification. They assess the merits of two different proposals and write an argumentative essay in support of the project they believe most merits further funding.

Curriculum alignment

### Science

[AC9S9H02](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/science/year-9/content-description?subject-identifier=SCISCIY9&content-description-code=AC9S9H02&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick) – investigate how advances in technologies enable advances in science, and how science has contributed to developments in technologies and engineering

[AC9S9H04](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/science/year-9/content-description?subject-identifier=SCISCIY9&content-description-code=AC9S9H04&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick)   – examine how the values and needs of society influence the focus of scientific research

[AC9S9I08](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/science/foundation-year_year-1_year-2_year-3_year-4_year-5_year-6_year-7_year-8_year-9_year-10/content-description?subject-identifier=SCISCIY9&content-description-code=AC9S9I08&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=8&view=quick) – write and create texts to communicate ideas, findings and arguments effectively for identified purposes and audiences, including selection of appropriate content, language and text features, using digital tools as appropriate.

## Learning hook

Explore with students how sensitive our sense of smell is.

Select a perfume or fruit juice with a strong smell. Note: check with your class for any allergies first.

Add a few drops to a small plastic container and fill the remainder of the container with a set volume of water. In the next container, add more drops plus the water and so on until you have five samples of different concentrations. Code each sample with a random letter and keep a key that matches the code to the number of drops.

Ask students to order the samples from strongest (most pungent) to least pungent odour. Note: depending on what you are using to create the odour, you may need to experiment with concentrations to get a good range of pungency.

As a class, collect the data and identify where students typically made mistakes. Is it in the same place on the concentration gradient? Was it easier to smell and compare the first samples rather than the last ones?

Girls in focus: By providing a learning hook that requires no background knowledge, all students can participate. Students with a particularly sensitive sense of smell can be encouraged to reflect on why they think their sense of smell is more developed. Have they been closely involved in cooking? Do they appreciate perfumes. Are there particular scents they appreciate in nature?

## Learning input

Our sense of smell is part of our chemosensory system. It relies on molecules landing on our olfactory neurons, located in the roof of our nostrils, that then send electric signals to olfactory bulb in our brain. We then need to interpret that information.

Have students watch this short [Ted Ed video](https://www.youtube.com/watch?v=snJnO6OpjCs&feature=youtu.be) to appreciate how our sense of smell operates. They can also read more about how we make sense of scents [here](https://www.brainfacts.org/thinking-sensing-and-behaving/smell/2015/making-sense-of-scents-smell-and-the-brain).

Students may be interested to learn that although it has been thought humans’ sense of smell is inferior to other animals, [recent studies](https://www.smithsonianmag.com/science-nature/you-actually-smell-better-dog-180963391/) indicate it’s more a difference in level of sensitivity to different odours.

Illness changes the way people smell, as we breathe out volatile organic compounds (VOCs). VOCs can provide early indications of disease, and some animals can detect these VOCs at very low concentrations. For example, dogs can detect hormonal fluctuations, diseases such as different types of cancer and even depression.

## Learning construction

#### Share with students that over the past two decades there has been increasing interest in the potential of training animals to smell human disease. More recently, scientists have been inspired by this work to develop disease-detection technologies that analyse human odours. For example, Dr Noushin Nasiri, influenced by dogs’ smelling capabilities, has developed a [nano sensor that can detect changes in human biochemistry](https://www.nssn.org.au/news/2019/7/19/sensors-replicating-dogs-noses-smell-cancer).

#### Explain to students that government and research organisations need to select where to invest funding for research. Given the human and economic cost of disease globally, early detection of disease is a priority research area.

#### Ask students to answer the question, where should funding be invested – in training and understanding animal disease detection or in developing technologies that replicate this ability?

#### Students can build their argument by listing the pros and cons of each approach. For this, they can start with the articles listed in the Resources section below, then identify where they need more information and conduct their own research.

#### In addition to pros and cons related to efficacy or efficiency, students can weigh the ethical, social, environmental and economic implications of each research approach.

#### Students then use the research to decide where the funding priority should lie and write an argumentative essay to make their case.

#### Support students to complete the essay by encouraging them to plan out the structure of the essay first:

#### the **introduction** where they state their position on the topic

#### the **body**where they explain the main points that support their position

#### the **conclusion** where they rephrase their position and summarise their main points.

Girls in focus: Girls respond well to choice and socio-scientific issues, so providing them with a rich scenario and asking them to evaluate their own response has the potential to engage them in the application of STEM.

## Resources

Video: [How do we smell? Rose Eveleth](https://www.youtube.com/watch?v=snJnO6OpjCs)

Article: [You actually smell better than a dog](https://www.smithsonianmag.com/science-nature/you-actually-smell-better-dog-180963391/)

Video: [Gender Equity Symposium: Noushin Nasiri](https://www.youtube.com/watch?v=_8bEm-nsKoQ)

Article: [Making sense of scents: smells and the brain](https://www.brainfacts.org/thinking-sensing-and-behaving/smell/2015/making-sense-of-scents-smell-and-the-brain)

Profile: [Noushin Nasari](https://www.stemwomen.org.au/profile/noushin-nasiri)

Article: [Dogs and bees can smell disease, so can nanosensors](https://www.nssn.org.au/news/2019/7/19/sensors-replicating-dogs-noses-smell-cancer)

## Background reading

## [How nanotechnology is achieving big results for health and medicine (University of South Australia)](https://giving.unisa.edu.au/news/how-nanotechnology-is-achieving-big-results-for-health-and-medicine/)

[Electronic nose accurately sniffs out hard-to-detect cancers (Penn Medicine)](https://www.pennmedicine.org/news/news-releases/2021/june/electronic-nose-accurately-sniffs-out-hard-to-detect-cancers)

[CRC Projects – Stretchable sensor technology helping health care workers (Australian Government Business)](https://business.gov.au/grants-and-programs/cooperative-research-centres-projects-crcp-grants/customer-stories/sleeptite)

[Barking up the Wrong Tree: The Trouble with Disease-Sniffing Dogs (McGill Office for Science and Society)](https://www.mcgill.ca/oss/article/covid-19-health/barking-wrong-tree-trouble-disease-sniffing-dogs)

[Olfactory detection of cancer by trained sniffer dogs: A systematic review of the literature (Science Direct)](https://www.sciencedirect.com/science/article/abs/pii/S1558787817300539)

[Sniffer ants can smell cancer better than dogs (BBC Science Focus)](https://www.sciencefocus.com/news/sniffer-ants-detect-smell-cancer/)

[Towards a disease-sniffing device that rivals a dog’s nose (MIT News)](https://news.mit.edu/2021/disease-detection-device-dogs-0217)

[The scent of sickness: 5 questions answered about using dogs – and mice and ferrets – to detect disease (The Conversation)](https://theconversation.com/the-scent-of-sickness-5-questions-answered-about-using-dogs-and-mice-and-ferrets-to-detect-disease-151832)