#### **Radioactivity refresher**

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Centre for Ecology & Hydrology NATURAL ENVIRONMENT RESEARCH COUNCIL

### **Atoms and atomic structure**

- Atom = smallest quantity of a chemical element
  - Key components:
    - Proton
    - Neutron
    - Electron
- Electrons surround the nucleus, equal in number to the protons
- Atoms have a small positively charged nucleus comprised of protons (Z) plus neutrons (N)
- Unbalanced Z & N = unstable isotope
  - stability through radioactive decay



## **Radioactive decay**

- Spontaneous process
- Unstable atomic nucleus loses energy by emitting ionizing radiation
- Activity = rate at which individual emissions of radiation occur



Expressed in units of Becquerels (Bq)

One Becquerel = one atom transformation per second

#### **Rate of radioactive decay**



## **Different types of radiation**

Radioactive isotopes found in nature emit three types of radiation:



Marie Curie's apparatus shows deflection of  $\beta$  rays from Ra

- α particles most massive, positive charge (helium nuclei)
- β particles negative
  charge, same as electron
- γ photons no electric charge, quanta of electromagnetic radiation

All three types can excite and ionise atoms.

#### **Radiation: internal AND exposure routes**

Bombus and Xylocopa spp. Rana arvalis Pelobates fuscus Bufo bufo Bombina bombina Myodes glareolus Muscardinus avellanarius Microtus agrestris and Microtus spp. Apodemus flavicollis Sorex minutus Sorex araneus Apodemus agrarius Lumbricus terrestris Agrostis gigantea Pinus sylvestris (wood)







# 'Exposure'

- Radionuclide activity concentration is measured in Bq kg<sup>-1</sup>
  - 1 Bq = 1 atom transformation [disintegration] per second
- How do we measure exposure
  - Absorbed dose (Gy) energy deposited per unit mass in a target [biological tissue]
  - 1 Gy = 1 J kg<sup>-1</sup>
  - Sievert (Sv) is a fiddled Gy and only appropriate to humans [we only use Gy for wildlife]





### Wildlife dose rates into context

- Predicted no effects dose rate for routine assessments 10 µGy/h
- No effects on animal populations <40 µGy/h & plant populations <400 µGy/h
- Natural background (UK)



Terrestrial animals and plants – 0.07-0.6 μGy/h (Beresford et al., 2008)





## **Questions?**

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