Forensic Profiling from a Radiologically Contaminated Scene

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  - Nuclear forensics meets conventional forensics
- Project objectives
- STR analysis
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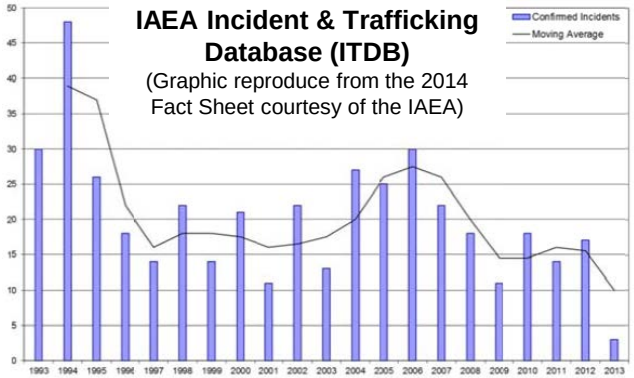
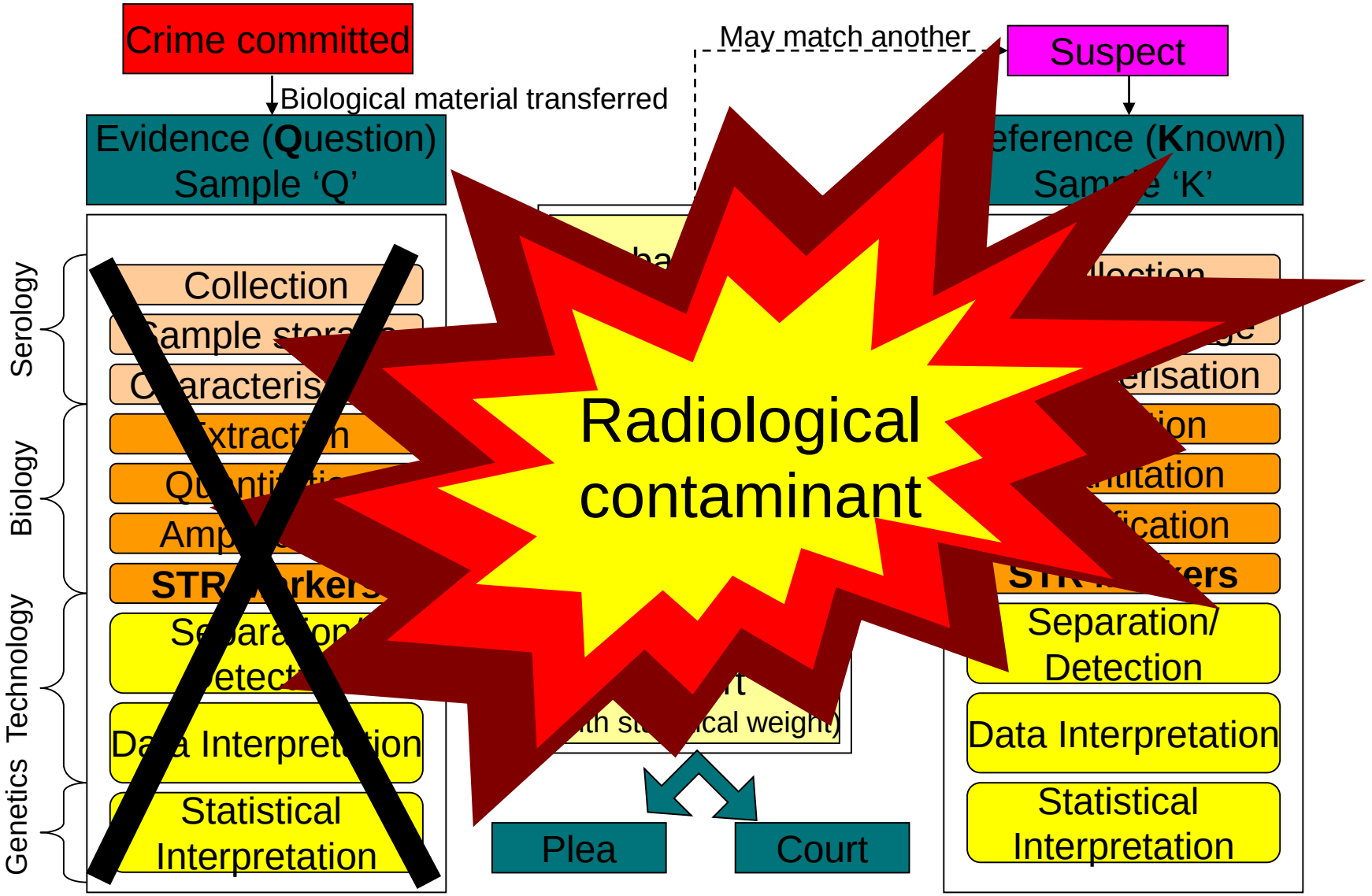
Types of radiological Incident

- Broad range of potential scenarios involving nuclear and other radioactive material out of regulatory control

- Since the early 1990's there have been a number of cases of illicit smuggling/trafficking of nuclear material
  - e.g. The interdiction of a small quantity of uranium at the Bulgaria border in 1999 (case-study given in Moody, Hutcheon & Grant, CRC Press (2005))

- Potential for the malicious use of nuclear or radiological material in a radiological dispersal device (RDD)





Conventional Forensic Analysis Capability (CFAC) at AWE

- Home Office have funded the development of a specialist laboratory at AWE to enable the conventional forensic analysis of radiological contaminated items

- ☑ Laboratory licensed to handle radiological material
- ☑ Laboratory designed for operations with radiological materials
- ☑ Broad range of traditional forensic science examinations possible:
  - ☑ Record photography
  - ☑ **DNA**
  - ☑ Trace evidence recovery
  - ☑ Digital data recovery
  - ☑ Fingerprints
  - ☑ Questioned Documents

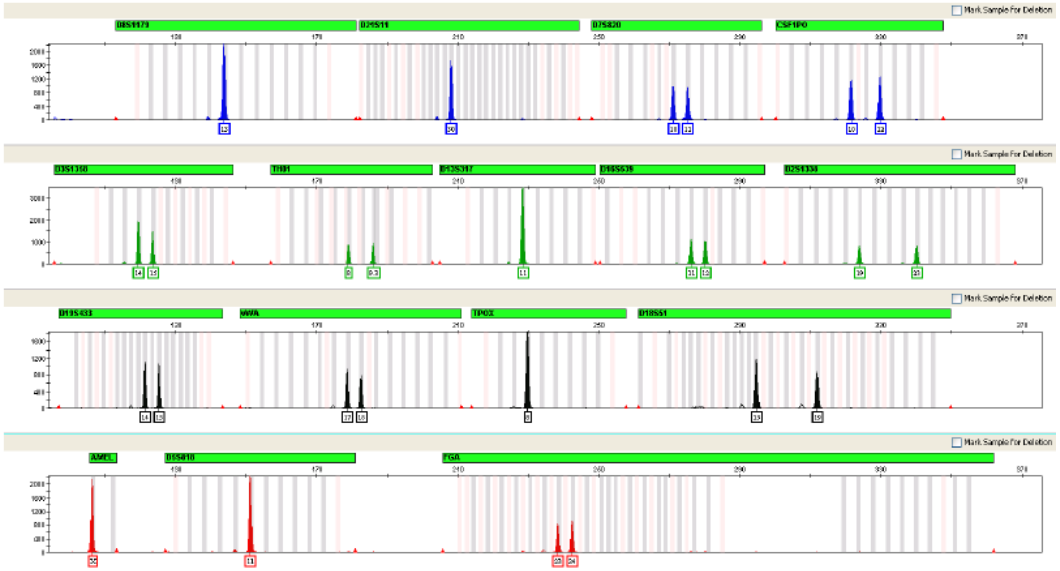
Project overview

- To gain an understanding of the potential effects on human DNA recovered from a crime scene / incident where an ionising radiation source or radioactive contamination could be present

- To establish a DNA laboratory capable of researching radiological material interactions with DNA

STR profile summary

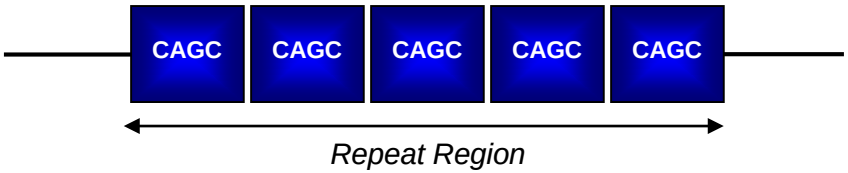
- Short Tandem Repeats
- Areas of repeated ‘junk’ DNA
- Variable between individuals
- 15 loci and gender identification
- 1:1 x 10^{18} probability of DNA match of non related individuals

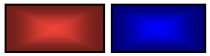


AMPF/STR® Indetifiler® PCR amplification DNA standard from manual

Short Tandem Repeats (STR)

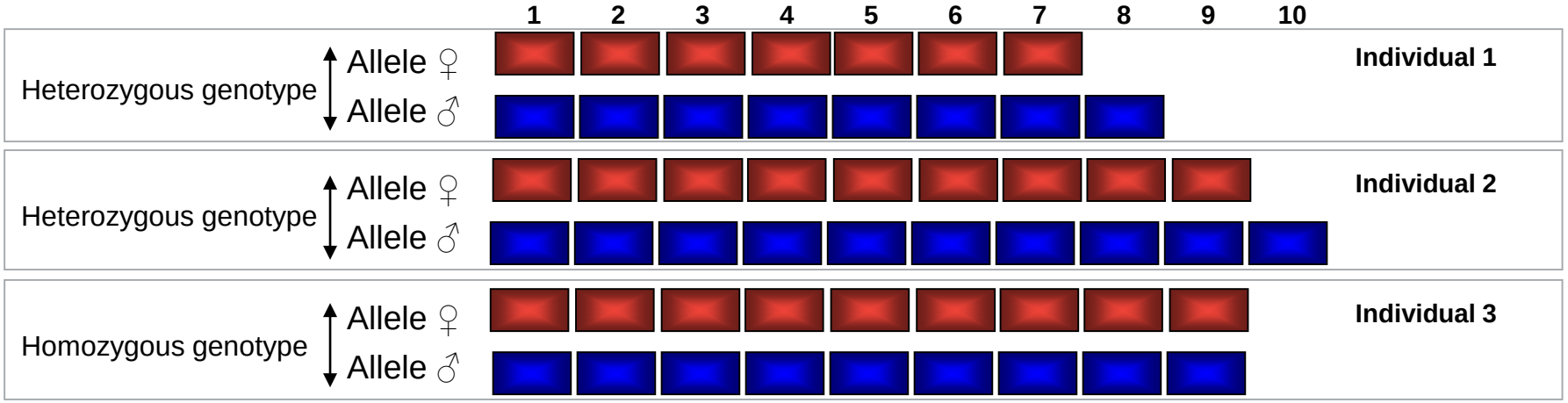
Area of chromosome of interest (loci)





Short Tandem Repeats

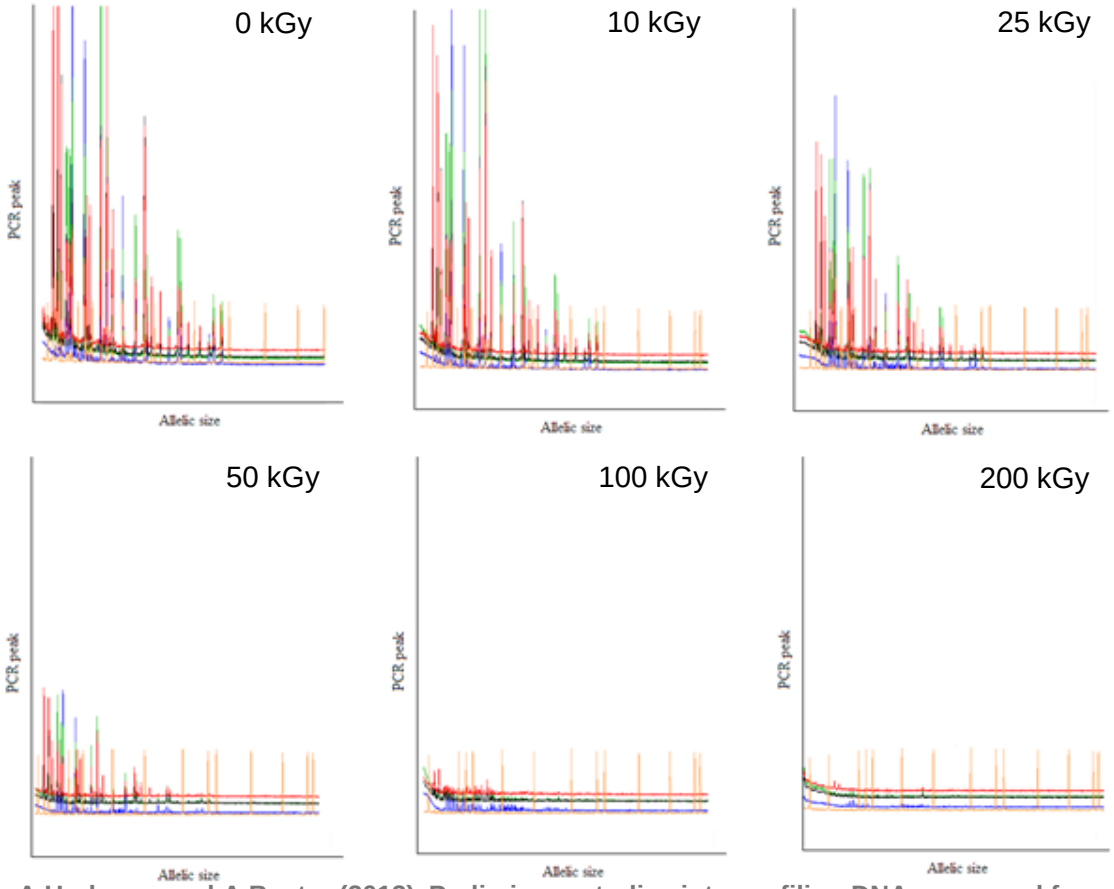
The number of STRs in a given loci



•Random match probability between individuals of ~10^{-18}

Previous work done at AWE

- Assessment of gamma irradiation on Buccal cells
- General decline in STR profile with increasing dose, as expected
- However, issues in STR amplification observed for both samples and controls
- Standard cells (BJ-5ta) will be undergoing irradiation



A Hodgson and A Baxter (2012) Preliminary studies into profiling DNA recovered from a radiation or radioactivity incident. Journal of radioanalytical and nuclear chemistry

DOI 10.1007/s10967-012-2088-0

Previous issues with irradiation work

- Quantification
  - Different prior to and post irradiation
  - At high doses, containers became brittle
- Solution
  - Avoid freeze thaw cycles
  - Irradiation to 60 kGy only with smaller increments between
  - Different containers used

Current irradiation work

- A further cell irradiation is planned
- Gamma irradiation undertaken at:
  - 0, 10, 20, 30, 40, 50 and 60 kGy
- Cells will be in two formats:
  - PBS solution
    - hTERT cell line BJ5tA
    - Buccal cells
  - Whatman FTA card
    - hTERT cell line BJ5tA
    - Buccal cells
    - Blood cells

Improvements to techniques

OLD

- Identifiler
- Quantifiler
- Ethidium Bromide
- MRC-9 and MRC-5 cell line

RETAINED

- QIAGen mini

NEW

- Indentifiler plus
- Indentifiler direct (needs ABI 3500)
- Quantifiler duo
- ChargeSwitch
- Gel Red
- BJ-5ta cell line
- QIAgen investigator
- Whatman FTA card

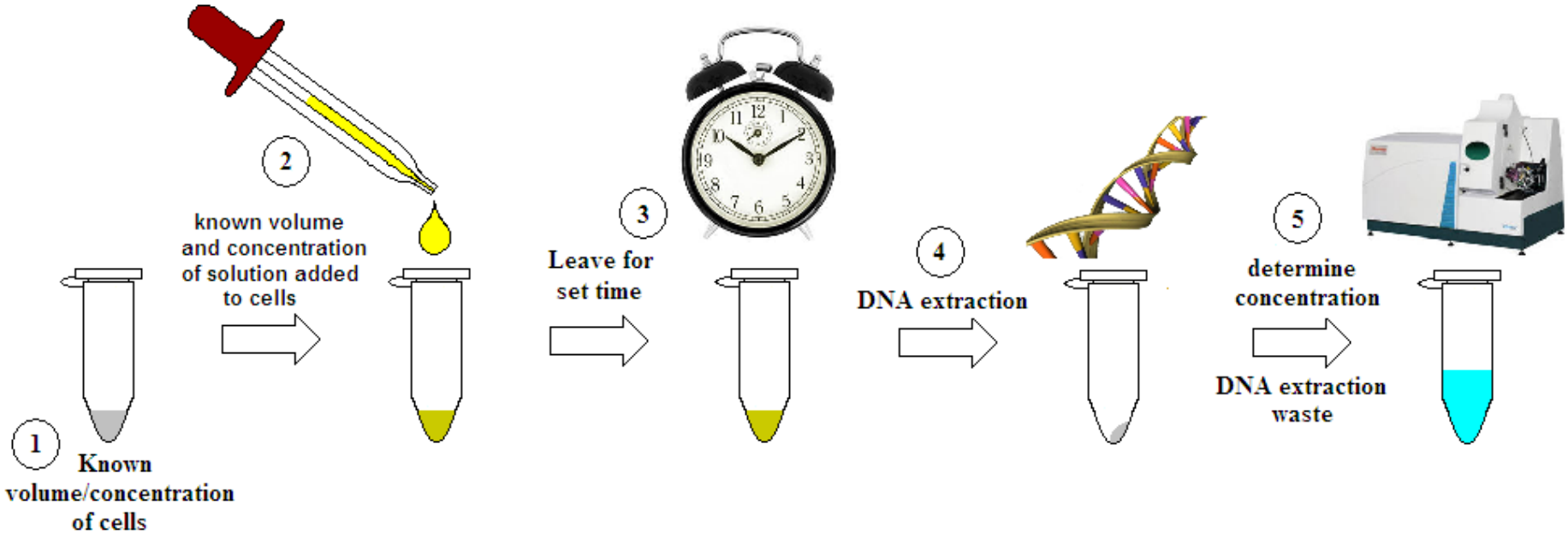
Decontamination of DNA

- Standard DNA extraction procedures may not allow decontamination
- Contaminants can cause degradation of DNA molecules or interfere with the extraction or amplification processes
- Removal of the contaminant will allow for storage of evidence for long periods of time without continued degradation

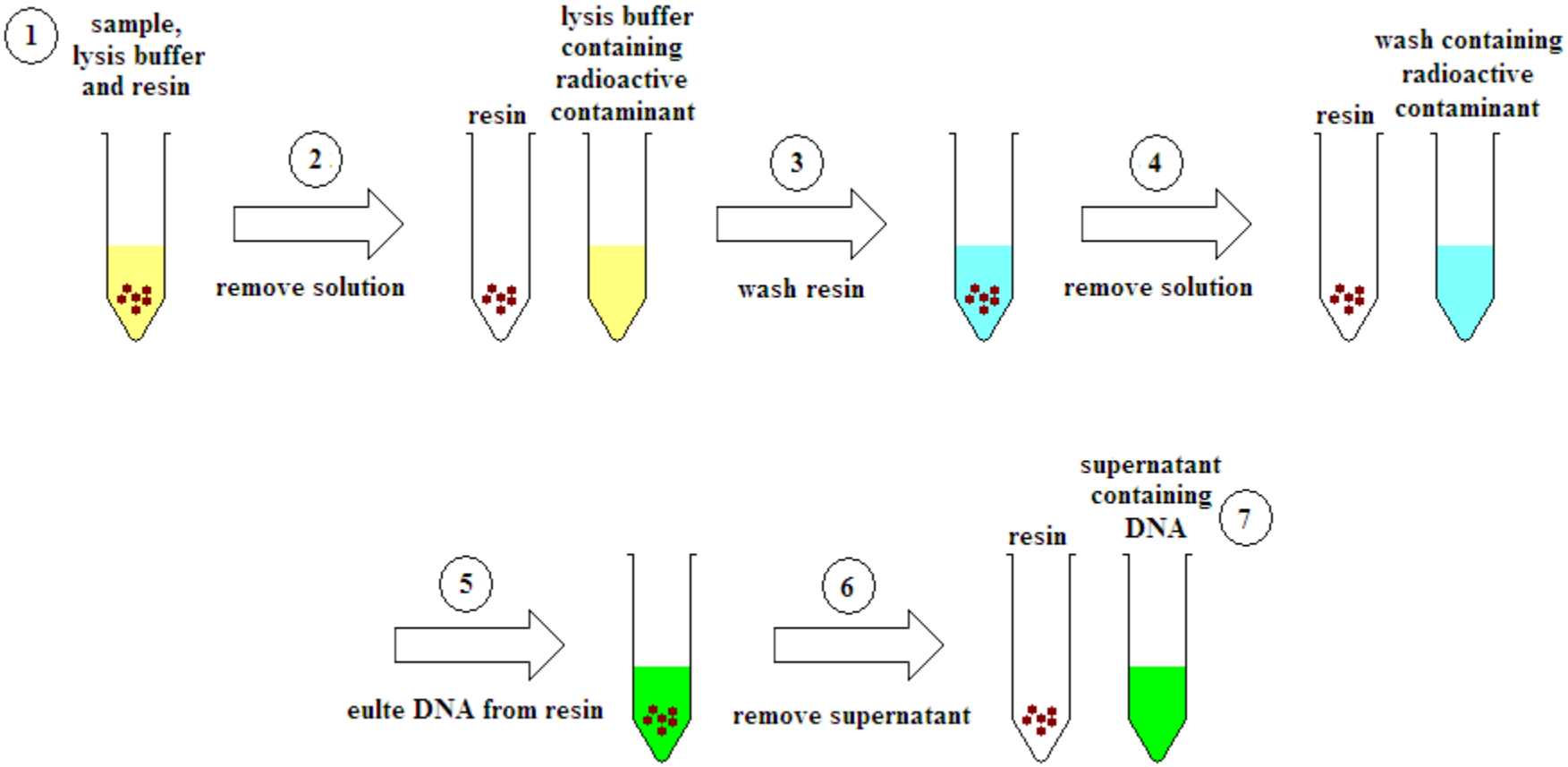
Initial Decontamination trial methods - AWE

- Qiagen DNA extraction kit/investigators kit
- ChargeSwitch®
- Standardised cell line (BJ-5ta)
- Initial experiment with known concentration at known timescale
- Increase timescale/concentrations

Suggested initial experiment



Decontamination scheme - ChargeSwitch



Any Questions