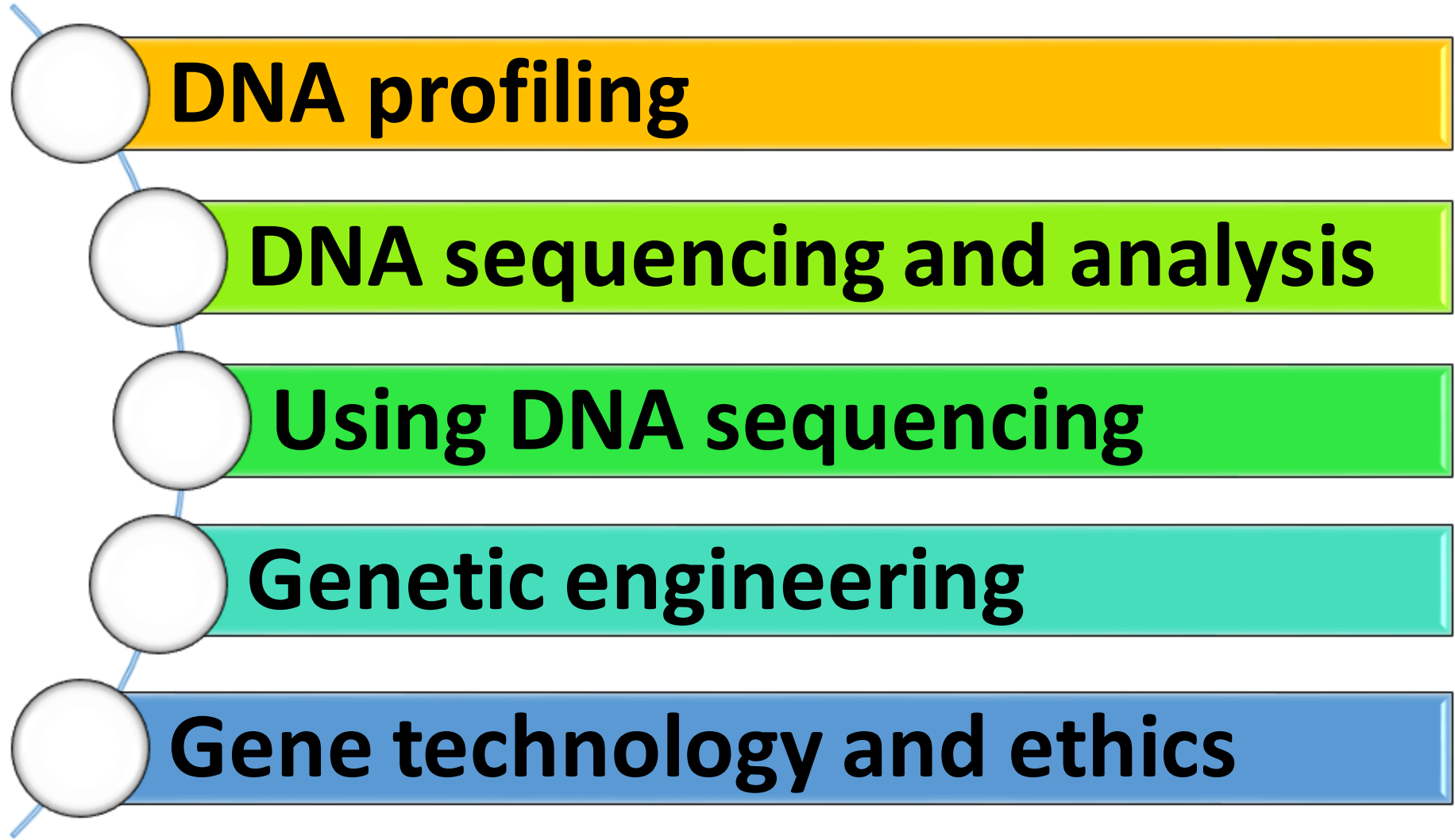


Manipulating genomes



Specification points: 6.1.3 Manipulating genomes

(a) the principles of DNA sequencing and the development of new DNA sequencing techniques

(b) (i) how gene sequencing has allowed for genome-wide comparisons between individuals and between species

(ii) how gene sequencing has allowed for the sequences of amino acids in polypeptides to be predicted

(iii) how gene sequencing has allowed for the development of synthetic biology.

Next generation sequencing – flow cells

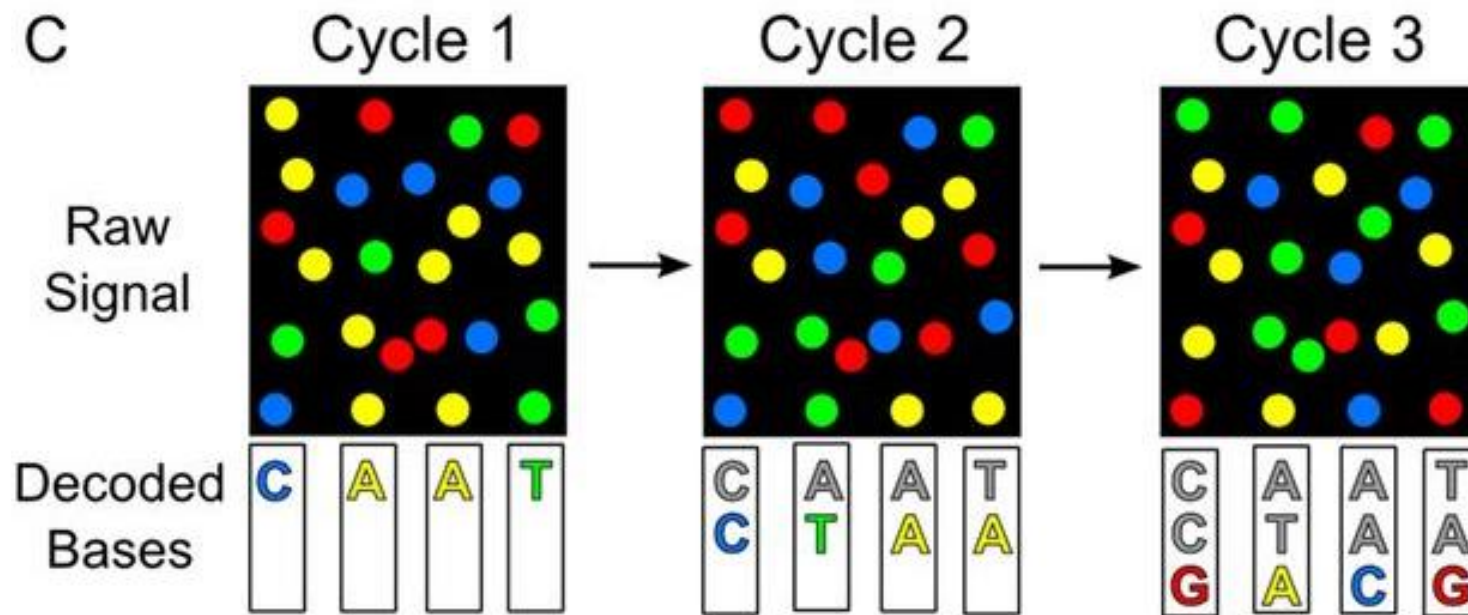
Advanced method much more commonly used now than capillary or gel plate method.

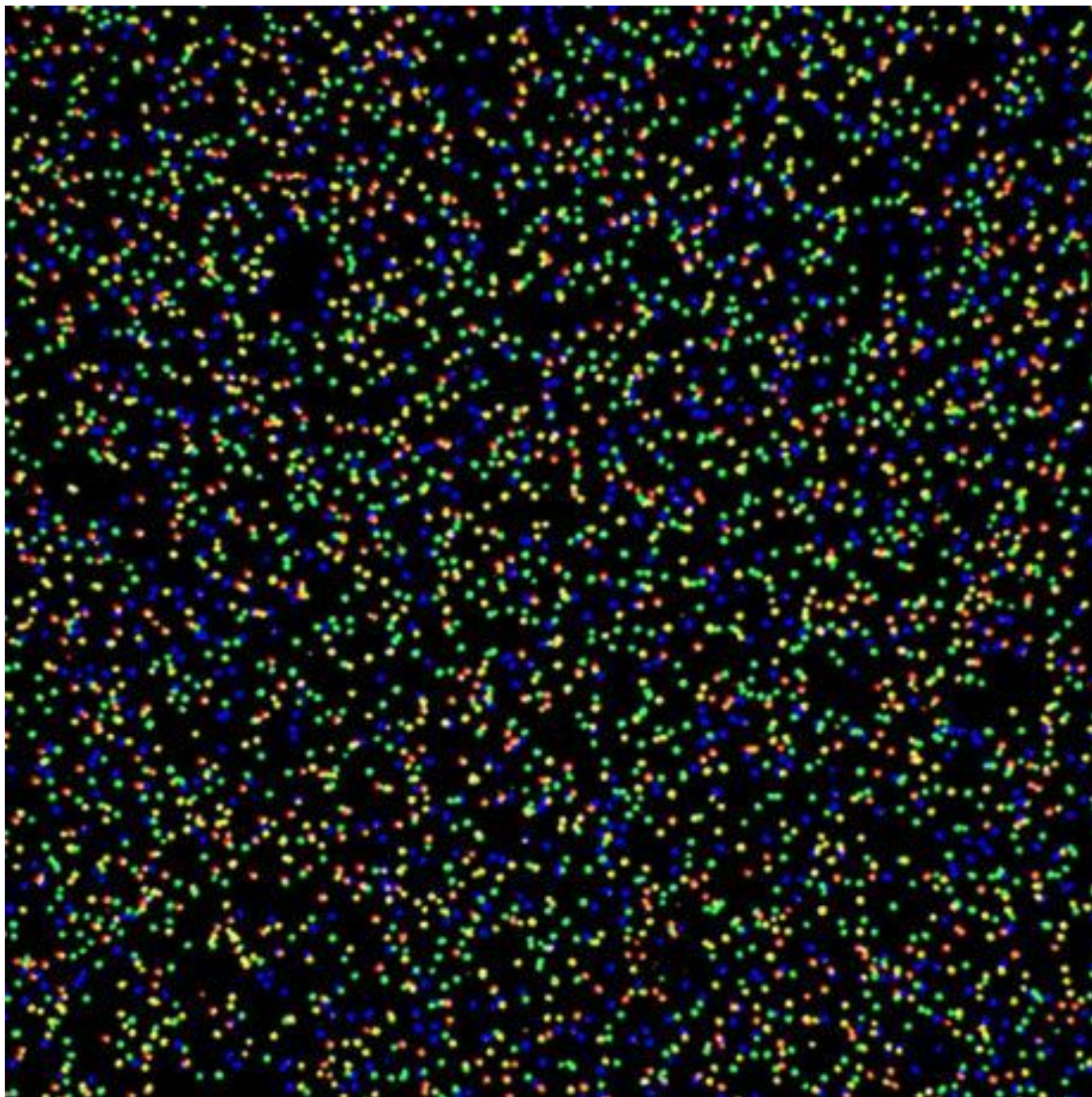
Faster – a day / few days to sequence a human genome.

Entire genome can be sequenced in one go.



Next generation sequencing: "massively parallel sequencing". Version called pyrosequencing; Multiple pieces of DNA on a plastic slide (flow cell). Terminator bases added one at a time and colours recorded.



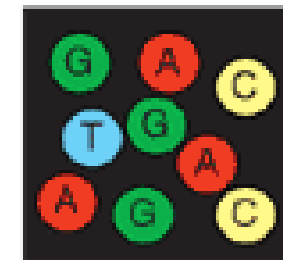


Cyclic array sequencing ($>10^6$ reads/array)

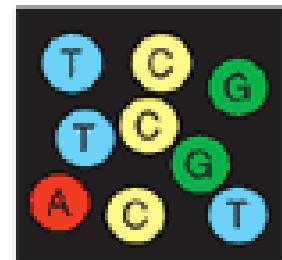
Cycle 1



Cycle 2



Cycle 3



What is base 1? What is base 2? What is base 3?

Next generation sequencing –

- Whole genomes can be read within days (it took years to do the first draft of the human genome).
- Costs have massively fallen.
- Opens up possibilities in many fields such as synthetic biology, medicine etc.

Next generation sequencing – flow cells

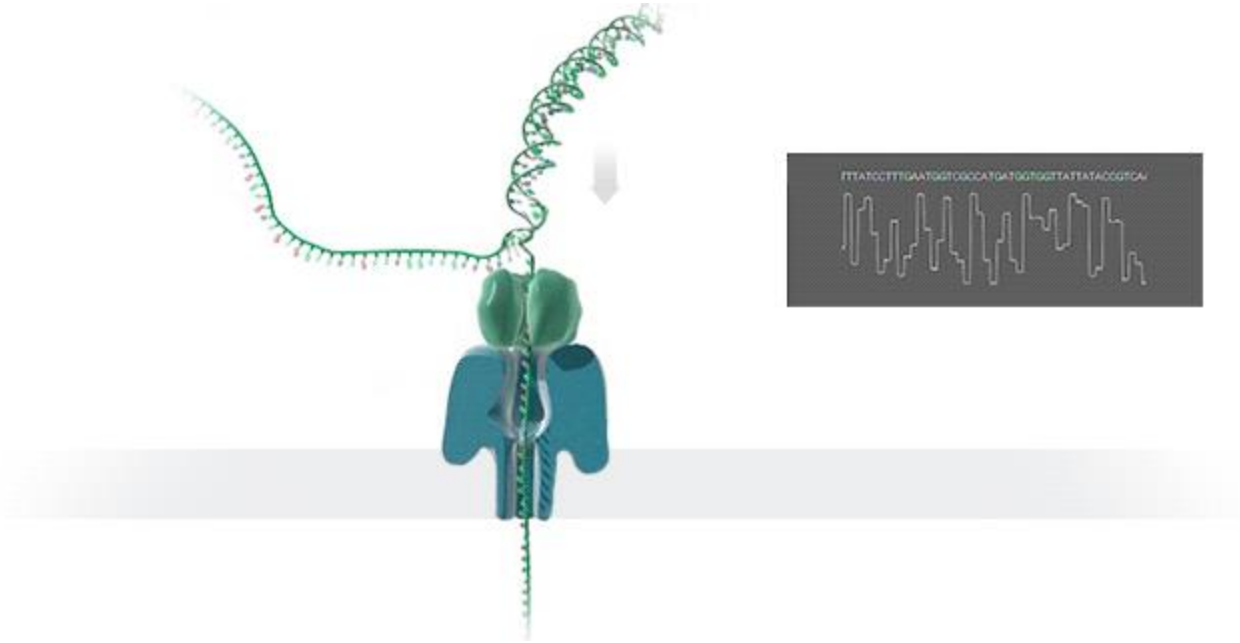
Overview of flow cell massively parallel sequencing – start from 0.39.
You don't need to learn the details, but exam questions may give you the details then ask questions. You should have an overview of why it is a better method and how it could lead to developments in understanding.

- Fragment cellular DNA
- Amplification by PCR
- DNA sequencing method
(using four color-labeled reversible chain-terminating nucleotides)
- Sequence assembly



Nanopore sequencing

You don't need to learn the details, but exam questions may discuss any new technique and ask you to interpret information given.



A nanopore is a nano-scale hole. A strand of DNA is passed through a nanopore. The current is changed as the bases G, A, T and C pass through the pore in different combinations. This change in current is measured and can be used to identify that molecule.

Nanopore sequencing

<https://nanoporetech.com/applications#>

Nanopore sequencing offers advantages in all areas of research...



Microbiology



Environmental
research



Microbiome



Basic genome
research



Human genetics



Cancer research



Clinical research



Plant research



Transcriptome
analysis



Population-scale
genomics



Animal research