

DNA Amplification

- Using the technique called **polymerase chain reaction (PCR)**, researchers are able to create vast quantities of DNA identical to trace samples. This process is also known as **DNA amplification**.

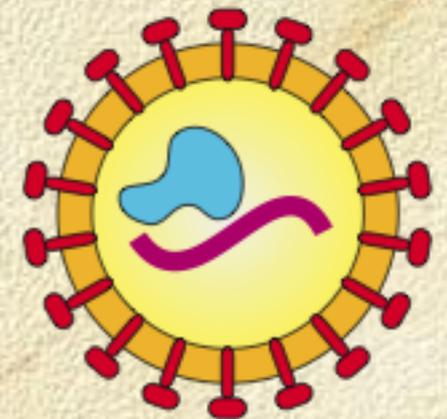
- Many procedures in DNA technology require substantial amounts of DNA to work with, for example;

- DNA sequencing
- DNA profiling/fingerprinting
- Gene cloning
- Transformation
- Making artificial genes

- Samples from some sources, including those shown here, may be difficult to obtain in any quantity.



A **crime scene**
(body tissue samples)



A **single viral particle**
(from an infection)



Fragments of DNA from
a long **extinct animal**

PCR Equipment

- Amplification of DNA can be carried out with simple-to-use **PCR machines** called **thermal cyclers** (shown below).
- Thermal cyclers are in common use in the biology departments of universities as well as other kinds of research and analytical laboratories.



The Process of PCR 1

- 1 A DNA sample called the **target DNA** is obtained
- 2 DNA is denatured (DNA strands are separated) by heating the sample for 5 minutes at 98°C
- 3 Primers (short strands of mRNA) are annealed (bonded) to the DNA

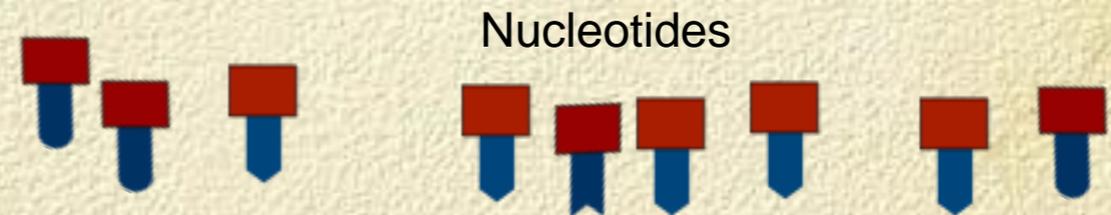
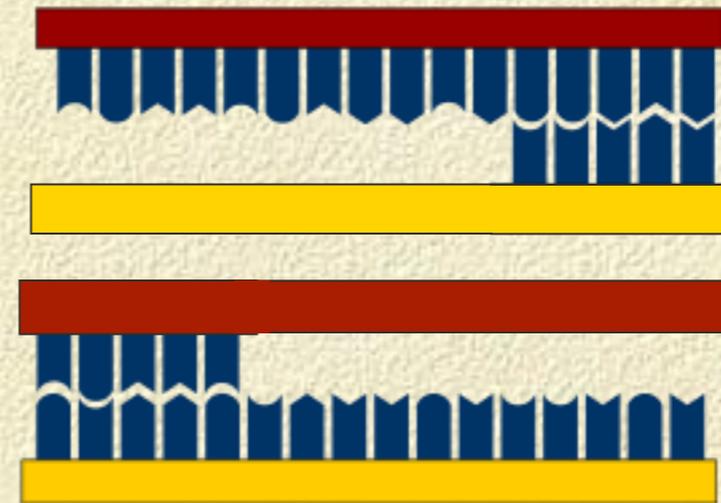


Primer annealed



The Process of PCR 2

- 4 The sample is cooled to 60° C. A thermally stable **DNA polymerase** enzyme binds to the primers on each side of the exposed DNA strand. This enzyme synthesizes a complementary strand of DNA using free nucleotides.



- 5 After one cycle, there are now two copies of the original sample.

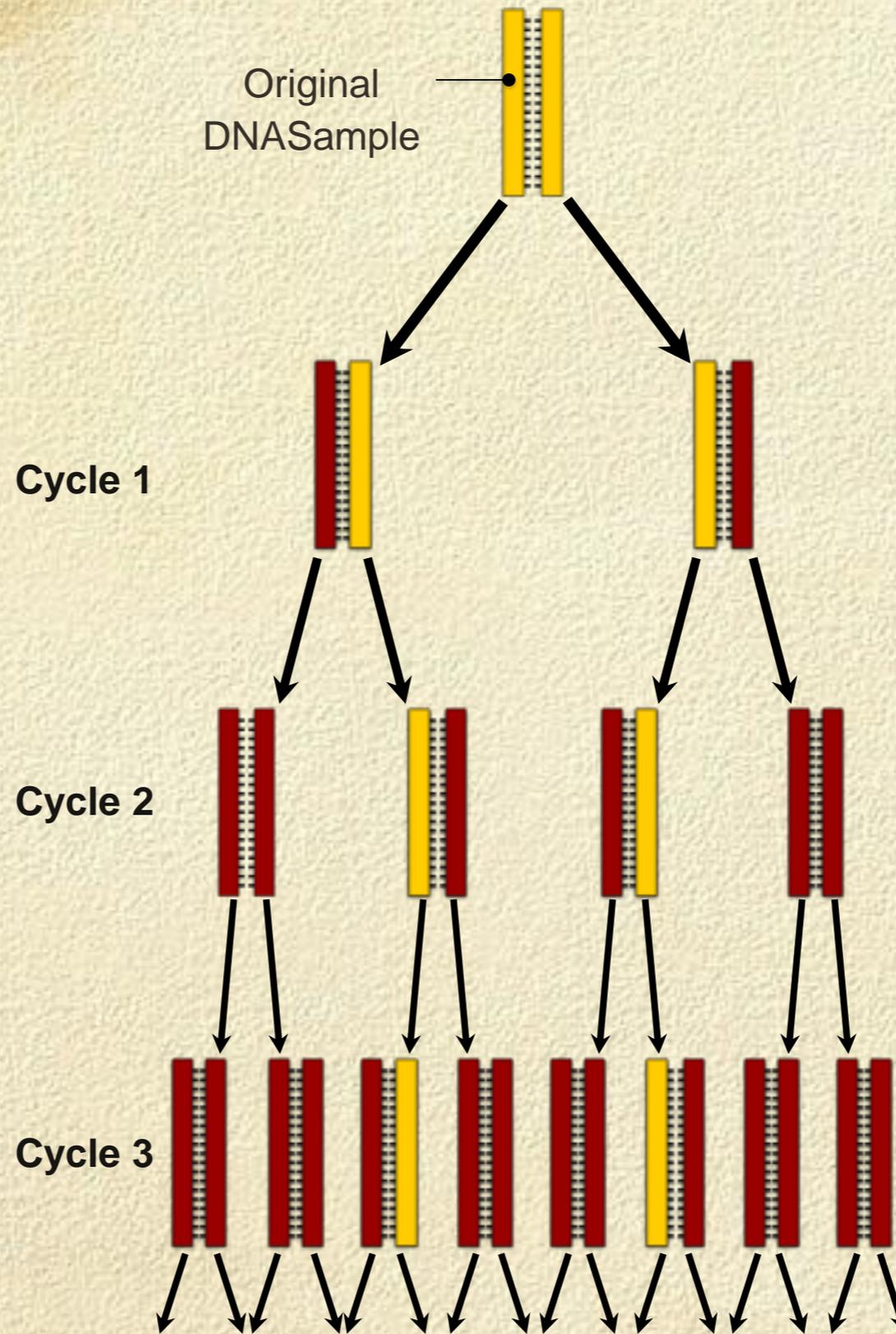


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Polymerase Chain Reaction

Although only three cycles of replication are shown here, following cycles replicate DNA at an **exponential rate** and can make literally billions of copies in only a few hours.



PCR cycles	No. of target DNA strands
1	2
2	4
3	8
4	16
5	32
6	64
7	128
8	256
9	512
10	1024
11	2048
12	4096
13	8192
14	16 384
15	32 768
16	65 536
17	131 072
18	262 144
19	524 288
20	1 048 576
21	2 097 152
22	4 194 304
23	8 388 608
24	16 777 216
25	33 554 432