Inside the factory HL

60 minutes • A2.3.1 to A2.3.4 • Chapters 1, 2, 3, 4

Features shared by all viruses, their diversity, and the lytic and lysogenic cycles of phage lambda

BY THE END, STUDENTS CAN

- [ ] List the features all viruses share: small fixed size, DNA or RNA, a protein capsid, no cytoplasm and few or no enzymes A2.3.1
- [ ] Describe the diversity of viruses, using phage lambda, coronaviruses and HIV A2.3.2
- [ ] Outline the phases of the lytic cycle of phage lambda, and what the virus takes from its host A2.3.3
- [ ] Outline the lysogenic cycle of phage lambda A2.3.4

TIMING

0-6	6 min	Do now: why no antibiotics?	
6-18	12 min	Genes in a box, no two alike	
18-32	14 min	Lytic and lysogenic	
32-54	22 min	Life cycle cards	
54-60	6 min	Exit	
	60 min	One lesson	

STARTER

6 min

Do now: why no antibiotics?

A doctor will not give antibiotics for a cold. Students write why, then share.

ON THE BOARD, FROM THE GUIDE

Open the guide on the projector at each chapter (the links work in this PDF). Every figure plays from its own buttons, and the lesson's slides have the same figures, step by step, in the order of this plan.

01 Genes in a box

CHAPTER 01 IN THE SLIDES

Tap the parts of the figure in turn: Nucleic acid, Enzymes, Capsid and Small, fixed size.

> **Predict box:** Why can a virus not be grown in a dish of sterile nutrient broth, as bacteria can? Hands up or mini whiteboards first.
>
> **Answer B: It has no ribosomes or enzymes of its own, so it cannot use the nutrients without a host cell**

02 No two alike

CHAPTER 02 IN THE SLIDES

Switch the figure through Phage lambda, Coronavirus and HIV, and have the class say what will change before each.

> **Predict box:** Soap breaks up lipid membranes. Which of the three viruses would soap affect least? Hands up or mini whiteboards first.
>
> **Answer B: Phage lambda, because it has no envelope and its protein capsid has no lipid for soap to dissolve**

03 Take over, burst out

CHAPTER 03 IN THE SLIDES

Play the animation, Phage lambda: lytic or lysogenic. It loops; pause it on each moment below and ask what is happening (in the lesson slides it is a video).

1. A **phage lambda** lands on an *E. coli* cell, and the fibre at its tail tip binds a receptor protein in the outer membrane: **attachment**.
2. It **injects** its DNA down the hollow tail and through the cell envelope. The empty protein capsid stays outside.
3. Inside, the DNA's two sticky ends pair up and it closes into a **circle**. Going deeper: the ends are the cos sites, and the host's DNA ligase seals them.
4. **Lytic cycle.** A virus has few enzymes of its own: the host's enzymes, nucleotides and ATP **copy the phage DNA** many times.
5. The host's RNA polymerase transcribes the phage genes, and the host's **ribosomes** translate them into **phage proteins**: capsid proteins and tail parts.
6. The parts **assemble**: a copy of the DNA is packed into each new head, and a tail joins on.
7. Enzymes made from phage genes break down the cell wall from inside. The cell bursts: **lysis**.
8. About a hundred new phages are **released**, each able to infect another cell. The host cell is dead.

> **Predict box:** A drug stops bacterial ribosomes working. What happens to phage lambda in a treated cell? Hands up or mini whiteboards first.
>
> **Answer B: No new phages are made, because the capsids, tails and enzymes are all made on the host's ribosomes**

04 Lying low

CHAPTER 04 IN THE SLIDES

Play the animation, Phage lambda: the lysogenic cycle. It loops; pause it on each moment below and ask what is happening (in the lesson slides it is a video).

1. A **phage lambda** lands on an *E. coli* cell, and the fibre at its tail tip binds a receptor protein in the outer membrane: **attachment**.
2. It **injects** its DNA down the hollow tail and through the cell envelope. The empty protein capsid stays outside.
3. Inside, the DNA's two sticky ends pair up and it closes into a **circle**. Going deeper: the ends are the cos sites, and the host's DNA ligase seals them.
4. **Lysogenic cycle.** A phage enzyme, **integrase**, cuts the host chromosome at one particular site and joins the phage DNA in. Now it is a **prophage**.
5. The prophage's genes for making phages are switched off. When the cell **divides**, the prophage is copied along with the chromosome.
6. So **every daughter cell** carries the prophage. No phages are made, and the cells live on.
7. Stress, such as **UV light** damaging the DNA, switches the prophage on, and it is **cut out** of the chromosome. Going deeper: the damage sets off the cell's SOS response, which inactivates the repressor that kept the prophage silent.
8. That cell enters the **lytic cycle**: the phage DNA is copied, new phages are made, and the cell bursts.

> **Predict box:** A culture of bacteria carrying the lambda prophage is exposed to UV light. What would be seen in the next hour? Hands up or mini whiteboards first.
>
> **Answer B: Many of the bacteria burst and new phages appear, as the prophages are cut out and enter the lytic cycle**

THE LESSON

12 min — **Genes in a box, no two alike**

Chapters 1 and 2 and their figures. Students fill a table of lambda, coronavirus and HIV: nucleic acid, strands, envelope, host.

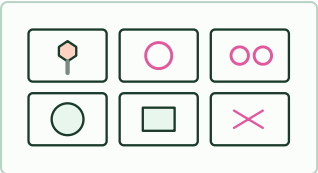
14 min — **Lytic and lysogenic**

Chapters 3 and 4 and the film, once each way. Students note at each step what the host supplies.

22 min — **Life cycle cards**

The SOLO life cycle cards below, then the lytic and lysogenic IB-style questions.

ACTIVITIES



CARDS

Virus life cycle cards

Cards of each step of the lytic and lysogenic cycles, shuffled. Pairs first sort them into the two cycles, then order each, then (the SOLO step up) link them: which card is the branch point, which steps the host supplies, and what event joins the lysogenic cycle back to the lytic one.

Needs: the card sets cut up.

EXAM QUESTIONS

Lytic and lysogenic questions

IB-style questions on phage lambda: outline the lytic cycle, distinguish the two cycles, and explain why a phage that can lie low as a prophage might be favoured. Marked against the markscheme.

Needs: the questions printed.

PLENARY

6 min

Exit

Give one advantage to the phage of each cycle.

WHAT STUDENTS GET WRONG

"Viruses are tiny bacteria." They have no cells, no cytoplasm and no ribosomes.

"The whole phage enters the cell." Lambda injects only its DNA; the capsid stays outside.

"In the lysogenic cycle the virus is asleep outside the cell." Its DNA is inside, part of the chromosome.

STRETCH AND SUPPORT

Support: give the captions of each figure and the film as a cut-up storyboard to put in order, and use the key terms (tap the dotted words) as a glossary.

Stretch: HIV's DNA copy is inserted into the chromosome of a helper T cell. How is that like lysogeny, and how is it different?

IN THE GUIDE

1 Genes in a box
2 No two alike
3 Take over, burst out
4 Lying low
All The whole guide, with the figures that play
PPTX This lesson's slides, in the order of this plan

EXAM PRACTICE

Check yourself

Set it for homework: a fresh paper of exam-bank questions on A2.3 at higher level each time, marked as students go and saved to their Exam practice when they are signed in.

biologybybradford.com/exam-maker/sit?topics=A2.3&level=HL&paper=quiz&marks=15&src=ep

PRACTISE AND REVISE

BUILD FOR YOUR CLASS

- Tarsia puzzle, dominoes and picture reveal on A2.3, built from its key terms and ready to print
- A pub quiz with rounds on A2.3, to present or run with no projector
- An escape room built from the question bank on A2.3

ALREADY ON THE SITE FOR A2.3

- Quiz: Viruses (HL)
- Revision map: A2.3 Viruses, to fill in
- Exam questions: A2.3 in the exam maker, a paper with its markscheme

CARD SETS ON SPLYCR

Open a set to host it as a class game, or make a copy to edit.

- A2.3 Viruses (HL)

How this was made. The course structure, the activities and the teaching choices come from my own classroom, my presentations and my years of teaching IB and AP Biology. I use Claude, an AI, to help write and build the interactive guides, lesson plans, slides and practice questions, and to draw the diagrams and code the interactives. I direct the work and review it against the IB and AP specifications before it goes live.