

Delivery Guide - Mechanical Systems in Bikes

Overview

This topic Builds upon Bike maintenance by focussing on the mechanical principles that are present in bikes. The intention of this unit is that it links the practical skills learned when maintaining bikes to the scientific and mechanical principles behind them, encouraging learners to explore why they are performing maintenance tasks.

Resources

Digital

https://www.youtube.com/watch?v=vZse_cAZS6c&list=PLwgc0AV1uSx55AYh8E5mcw34Cq6qy3kDx&index=3

This video introduces Fix, one of the Bikeability Plus modules available.

https://www.youtube.com/watch?v=U_Rnr_fIVq8

This video, from Cycling Pulse, explains how both cable and hydraulic brakes work. It also explains some of the benefits of disc brakes over rim brakes.

<https://www.youtube.com/watch?v=DQmmEvt0rxs>

This video, from Park Tool, explains how derailleurs work. This includes explaining the relationship between cable tension and springs.

<https://www.youtube.com/watch?v=B2sKhSDrugE&list=PLGCTGpvdT04QGVs-Z6tQCpjLi2X-qTx&index=2>

This video, from Park Tool, demonstrates how to clean a bike, which includes identifying a wide range of parts and discussing cleaning products and lubrication.

<https://www.youtube.com/watch?v=PN1mdCQS8hw>

This video, from GMBN, explains common cleaning mistakes which provides information about cleaning products and how components wear.

<https://www.youtube.com/watch?v=aOHhelwXLBs&list=PLJ8xH51lwVikQNc4861BHgNQ47oiZpP5u&index=7>

This video, from Breaking Cycles CIC, demonstrates home maintenance tasks, including bike cleaning and checking wearable components. It shows some 'low-tech' alternatives that can be used if you don't have access to professional tools.

https://www.youtube.com/playlist?list=PLMAob0Iss4NlzOpSJ9KkVEf2b9GSPER_R

This playlist, from Cycling UK, shows a range of bike maintenance skills.

https://www.youtube.com/watch?v=V09cVdPq_uY

This video, from GCN, suggests a range of solutions for dealing with a rounded Allen bolt head.

This video, from GMBN, explains some common errors people make with brakes and explains chemicals used in maintenance as well as how the systems work.

Physical

A bike that can be worked on

Brake callipers and derailleurs to examine and experiment with

Lubricants and cleaning products

Essential Tools

- Allen key set
- Spanners or an adjustable spanner
- Screw drivers

Tools which would be advantageous

- Work stand
- A home maintenance bike toolkit with a selection of specialist tools
- Needle nose pliers
- Mallet
- Chain wear indicator

Subject knowledge

To deliver this unit, a basic understanding of mechanical principles is needed, and it would be beneficial if the deliverer also has a good working knowledge of bicycle components, which will be particularly useful for supporting learners with acquiring subject specific vocabulary.

If working on learners' own bikes, the deliverer holding a bike mechanic qualification such as Cytech would be advantageous so that they can confidently say that the bike is safe to ride after sessions where work has been done.

Activity ideas

We would strongly recommend that this topic is delivered after the Bike Maintenance topic, building upon their experience and focussing on why and how things work.

If the learner(s) prefer a hands-on approach, working through the learner work booklet while they practice skills on a bike, dismantling components and putting them back together to explore how they work etc. would be the optimum method of delivery. The digital resources identified above could then be used as a reference point if additional clarification is needed.

If the learner responds well to a theoretical approach, the topic can be delivered by working through the Learner work booklet, accessing online resources and performing mechanical tasks to demonstrate their ability to use tools and work methodically. This would reduce the need for physical resources.

If possible, organising a visit to a local bike workshop would be a good addition to the delivery of this topic.

Evidencing completion of the unit

Level 1 ([Unit Code: 117895](#))

Outcomes

demonstrated the ability to

1. explain how a component works
2. identify worn parts that might need replacing
3. choose an appropriate tool for a given task

shown knowledge of

4. two bicycle components that use bearings
5. two components that use springs
6. two components that need to be regularly lubricated
7. a component which relies on friction to work properly
8. two maintenance tasks that help components to last longer
9. why moving parts need to be lubricated
10. the role of friction in the mechanical operation of a bicycle.

Evidence

1. The learner should identify key parts in their answer, explaining the process in stages. If completing the prose exercise in the learner work booklet, I would expect a response like: When you pull the brake lever, the cable pulls the calliper together. The brake pads touch the rims and slow the bike down. When you let go of the lever, springs open the calliper up again. If this is done verbally or practically, expect a similar level of detail and record it on the summary sheet.
2. Record the date you have seen this knowledge demonstrated on the summary sheet or mark the learner work booklet. They should label the diagram with more than just the name of the component. They should identify two separate components e.g., brake pads and tyres and not front tyre and back tyre.
3. Record on the summary sheet when you have witnessed the learner selecting the correct tool for a task. An example of this would be trying both a 4mm and 5mm Allen key in a bolt head to check which one fits.
4. Record the date you have seen this knowledge demonstrated on the summary sheet or mark the learner work booklet. They may label the diagram with just the name of the component in this instance. Expect responses like headset, wheel bearings, bottom bracket or pedal bearings.
5. Record the date you have seen this knowledge demonstrated on the summary sheet or mark the learner work booklet. They should label the diagram with more than just the name of the component. Expect responses like brakes, derailleur or suspension with an explanation like 'the brakes have a spring to open the calliper back up when you let go of the lever'
6. Record the date you have seen this knowledge demonstrated on the summary sheet or mark the learner work booklet. They should label the diagram with more than just the name of the component. Expect responses like 'the chain needs lubricating, so it doesn't go rusty' or 'you need to lubricate suspension forks so that it moves smoothly'
7. Record the date you have seen this knowledge demonstrated on the summary sheet or mark the learner work booklet. They should label the diagram with more than just the name of the component. Expected responses are tyres or brakes.

8. The responses to this outcome should generalise the concept of reducing component wear. E.g., 'cleaning parts prevents grit from making things wear out faster' or 'lubricating moving parts helps them to move freely, which stops them from rubbing together and wearing out'
9. The responses to this outcome should generalise the concept of lubrication. E.g., 'when two surfaces rub together, it causes friction which can wear away the parts of make things get hot. When you lubricate them, it puts a slippery barrier in between so it reduces friction'
10. The responses to this outcome should generalise the concept of friction as a mechanical system in their bike. Expect a response like 'if we didn't have friction then the tyres would just spin, and the bike wouldn't move. If there isn't enough friction between the tyre and the road or trail, then it slips and can make you fall off or lose your momentum.'

Level 2 ([Unit Code: 117894](#))

Outcomes

demonstrated the ability to

1. suggest a way that a component could be improved
2. choose the appropriate tool for three maintenance tasks
3. suggest a solution to a mechanical problem
4. work in a methodical manner on a given mechanical task

shown knowledge of

5. three bicycle components that use bearings
6. two chemicals used in bicycle maintenance
7. two ways that components are protected from exposure to dirt and water
8. five components that should be regularly checked for wear

acquired an understanding of

9. the parts of a component that require regular maintenance
10. when wearable components are likely to need changing
11. how a hydraulic system works
12. how cable tension and spring tension interact in braking and gear systems.

Evidence

8. The learner should independently identify a component and say what the potential issue is and how to improve it. e.g., Jockey wheels on rear derailleur – attracting dirt and grit so they need cleaning to stop them wearing out. – It would be better if there was a plastic guard underneath so that less grit gets to them, and they don't need cleaning as often.
9. Record on the summary sheet when you have observed the learner using three different tools for three separate tasks. They should be completely different, e.g., Allen keys, spanner, screwdriver and not 5mm Allen key, 4mm Allen key...
10. The responses to this outcome should give enough detail to show that they have fully thought the solution through. E.g., 'I would use a hacksaw to cut a slit across the top of the bolt head so that I can use a flat headed screwdriver. It needs to be deep enough for the screwdriver to get good grip as its probably seized a bit if the head is rounded'
11. Record on the summary sheet when you have observed the learner working methodically, this could be by organising their tools well, following a step-by-step guide, using an m-check to make sure that they don't miss any components as they work through the bike when servicing it.

12. The learner should be able to show some understanding rather than just a simple label. E.g., 'The Headset has bearings so that the steering is smooth and doesn't wobble about.'
13. The learner's responses should contain some detail and reasoning, e.g. 'I would use a degreaser to clean compacted dirt off because its stronger than a normal bike cleaner' or 'Mineral oil is the most common hydraulic fluid, but there are different types for different designs'
14. The learner's response should refer to a design principle rather than a specific part. E.g., 'bearings often have a flexible plastic seal over them to stop water getting in. This works by creating an extra barrier.' Or 'some bikes have internal cable routing which means that there are no exposed cable inners, and the outers don't rub against the frame.'
15. The learner's response should give more detail, such as how it wears, rather than just the name of the component. E.g., 'chain stretch' rather than just 'chain' or 'no tread left on the tyre'. Expected responses include tyres, brake pads, chain, cassettes/freewheels, chainrings, cables and handlebar grips.
16. The learners' response should contain some detail and demonstrate an understanding of why they are performing the maintenance task. A good response to the scenario in the booklet would be: 'Clean any dirt from the jockey wheels so that they don't wear out, clean and lubricate the pivot points and spring, making sure that there is no dirt and grit left around the moving parts.'
17. The learners' responses should make comparative reference and acknowledge that there are differences between components of different brands and for different bike types. e.g., 'this brake pad has lots of material left, this one is well worn so needs replacing soon and this one is worn unevenly so the brake probably needs adjusting as well as fitting new pads.'
18. The learners' response might include actually making the model hydraulic system or designing it. Either way, it should demonstrate an understanding of the principle of displacing liquid to actuate the piston. E.g., 'when I squeeze the water out of this bottle, it goes through the hose into the calliper and pushes the pistons out. When they hot the disc and have nowhere else to go, I can feel it at the other end and add more pressure by squeezing harder.' They should also explain the purpose of a sealed system when using hydraulics. E.g., 'I will use a balloon and elastic band to create a seal so that the water doesn't squirt out rather than moving the piston.'
19. The learners' response should demonstrate a clear understanding of how tension forces interact as they describe the tension of both the cable and spring. E.g., 'when it is open, the spring has pulled the cable tight.' And 'when it is closed, the cable has shortened, pulling against the spring to open it up.'