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Bicycles 101

Repair and maintenance for beginners

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Introduction

Bicycles seem simple, but their upkeep can be intimidating for the uninitiated. This guide introduces the beginner cyclist to the basics of bicycle repair and maintenance. Where possible, the need to purchase specialized tools is avoided. This guide will describe each of the bicycle's parts, then explain some common issues each of these parts tend to have.

Note: This guide focuses mainly on the **road bike**, pictured on the title page. Some of the parts and maintenance tasks of other types of bicycle, like mountain, recumbent, or tandem bikes, might be absent. Be aware that your specific case may differ from the instructions.

History

At the time of its invention, the modern bicycle was a curious novelty as compared with the much more popular penny farthing. The farthing, with its massive front wheel upon which riders had to balance, introduced the danger of falling to the usual dangers of collision with others.

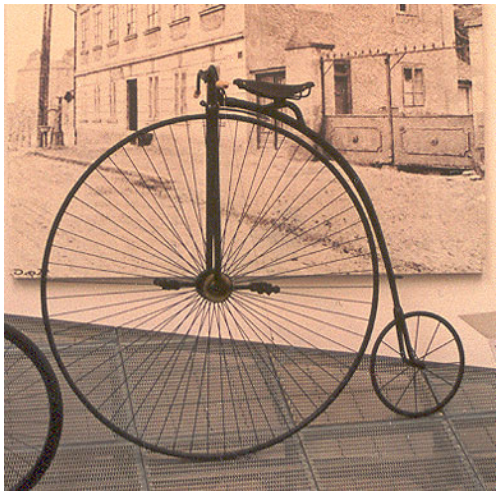


Fig. 1: The penny-farthing

So when a new type of bicycle came to the market that kept its riders low to the ground, it was introduced as the *safety* bicycle. Recent inventions like pneumatic tires and a chain-driven geartrain provided comfort and speed to match the farthing, and the safety bicycle quickly took over as the most popular.

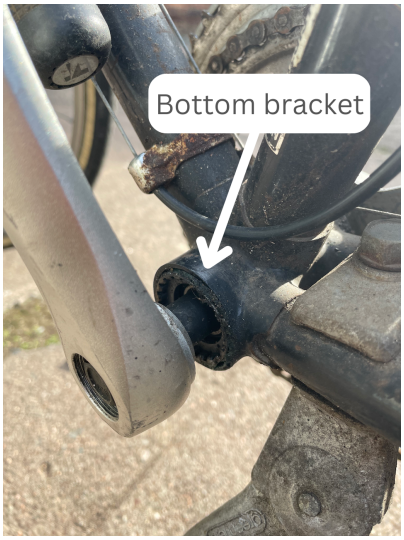
If you'd like a deeper understanding of quirks of history that created the modern bicycle, I'd recommend David V. Herlihy's *History of the Bicycle*.

Bicycle Anatomy

Ca. 1980s Univega Supra-Sport, a type of road bike.

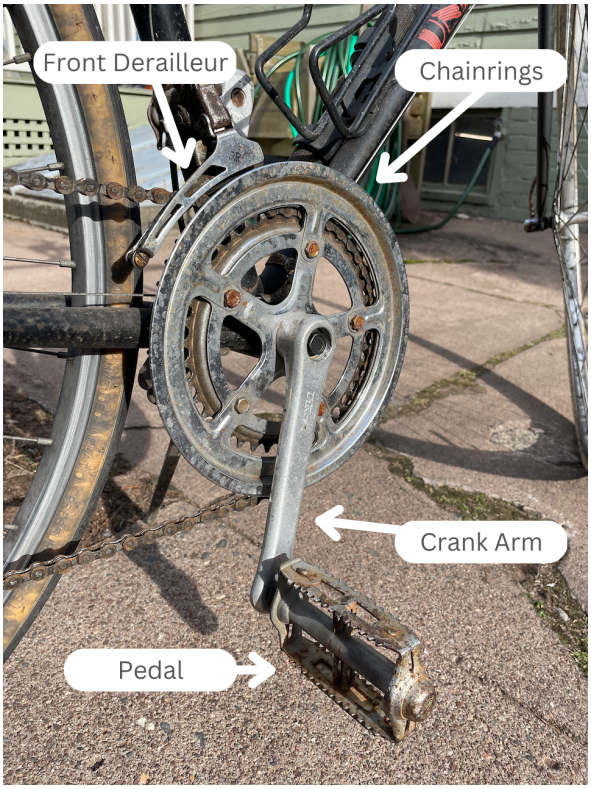
All bicycles are built on a **frame**. The frame can either be step-over, with a bar that runs straight across the top, or step-through, with space left between the handlebars and the saddle. A bike with a compromised frame is not usually salvageable, although its remaining parts can and should be recovered.

Drivetrain



At the bottom of the frame is a hollow tube called the **bottom bracket.** Inside the bottom bracket is a spindle that rotates freely on ball bearings.

Mounted on the spindle is the **crankset,** comprised of two crank arms, each with a pedal. The right crank usually features a set of one or more large gears. These gears are sometimes called **chainrings** because the bicycle's chain fits over them.



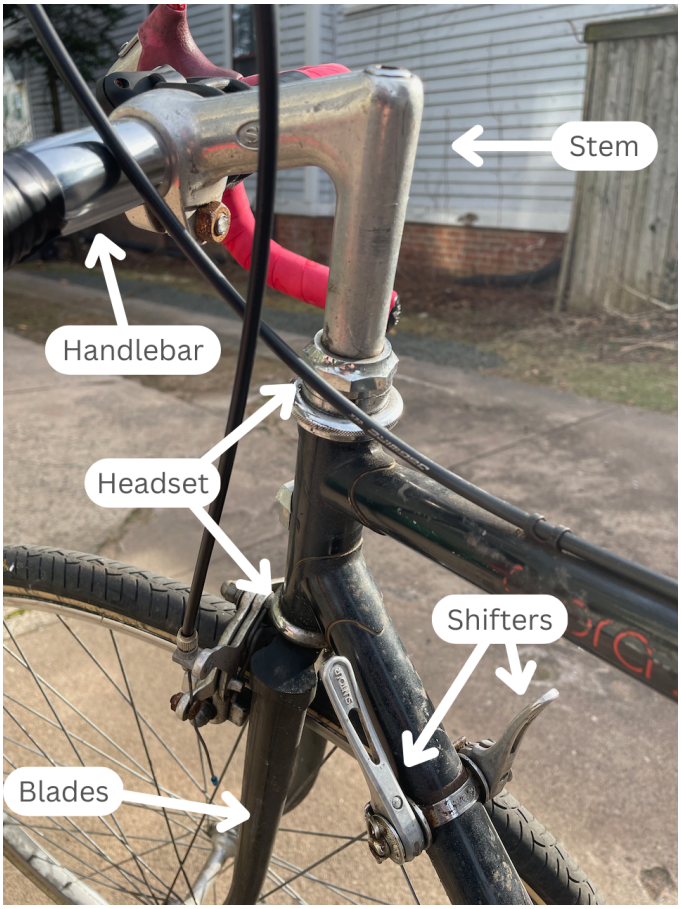
A spring-loaded shifting mechanism called a **derailleur** (a French word referring to train derailment) sits above these gears and around the chain. When you shift down, a cable pulls the derailleur to the left, forcing the chain down the series of gears. When you shift up, you release the tension on the cable, and the spring extends to move the chain up to the next highest gear.

The chain runs back to the rear wheel, where it loops over the **cassette,** another set of gears, although your bike may only have one. If it has more than one, the chain runs through another derailleur, which hangs below, to allow shifting up and down the cassette.

This whole assembly, from the bottom bracket to the rear wheel, is called the **drivetrain.** When you pedal, you turn the crank arms (which spin freely in the bottom bracket), which pulls the chain forward, which turns the cassette, which turns the rear wheel, moving you forward.

Fork, Headset, and Handlebars

At the front of the bicycle frame is the **fork.** Two “blades” flank each side of the front wheel, where they meet at the skewer, a rod that runs through the wheel’s axle. On mountain bikes, the fork may feature shock absorbers.

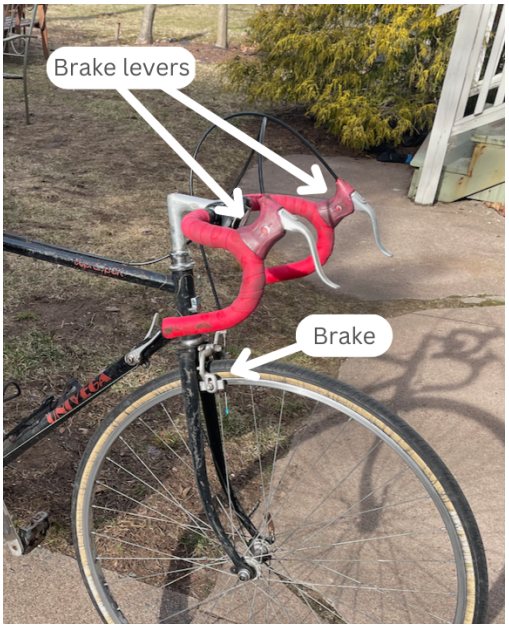


The fork is allowed to rotate independently of the frame, which lets you to steer, because it is fitted into an empty space on the frame called the head tube. At both the top and bottom of the head tube are cup and bearing assemblies which work to keep the fork secure. These assemblies are called the **headset**.

Into the top of the head tube fits the **stem.** Some stems can be adjusted up and down the head tube; others must be cut down to size. The stem sticks out and away from the head tube, and has a clamp at the front end. This clamp provides the space to mount handlebars.

Handlebars come in many shapes and sizes, including flat, drop bars, and cruiser bars.

Brakes and Shifters



On your handlebars you’ll find **brake levers**, which connect via cables to the brakes on your front and rear wheels. Fixed gear bikes might not have brake levers on their handlebars: this is because fixed gear bikes brake by pedaling in reverse, which locks the rear wheel in place, letting friction between the immobile tire and the road slow the bike.

Brakes come in three forms: disk brakes, which stop your bike by applying friction to a small rotor mounted to each wheel’s axle; rim brakes, which apply friction to the rim of the wheel; and v-brakes, which work

similarly to rim brakes but with a different design.

You might also find **shifters** on your handlebars, but they can also be located on the down tube of the frame or on the stem. If your bike is a fixed gear or single-speed, you might not have shifters at all. Like brakes, the shifter mechanisms are connected to the derailleurs via cables that run along the frame of the bike.

Saddle

The bicycle's seat, or **saddle**, is mounted to the frame on a seat post, which is inserted into the frame's seat tube. The saddle can be attached to the seat post via rails and clamps, or it may be attached directly to the seat post.

Maintenance and repair

If you rely on your bike to get where you need to go, whether to work, to school, or just around town, knowing how to fix it when things go wrong can be an essential skill. It's well worth *your* time to become familiar with even the bare minimum required maintenance—otherwise, you'll have to pay someone else for *theirs*.

And when one considers the dangers cyclists face on the road, preventative maintenance can take on a life-or-death importance: you don't want crucial parts failing when you need them most. This section details some common issues that you can learn how to fix—and more importantly, prevent—yourself.

But first, we'll start with a shopping list for the tools you'll need on hand.

Essential bike tools and supplies

Many of the tools at a bike shop are highly specialized. These tools accomplish one goal (usually something that you won't need to do very often), and they can get expensive. Rather than trying to recreate every drawer and wall of the bike shop at home, instead purchase the handful of tools that will see the most use for the least investment.

And if this list seems intimidating, know that you don't have to run out and snatch all this up all at once. Start at the top of the list and work down over time.

Here are the handful of tools and supplies you'll want to have on hand before jumping into bicycle repair, and where you can find them:

Chain Lube
Cost: $10-15
Purchase on Amazon

Bike chains need to stay lubricated to function properly. A dry chain is inefficient: less of the energy you put into the pedals is transferred to the rear wheel.

See *Lubricating a chain* for more information on application.

Tip: Some bike shops will give you a discount for refilling an empty bottle.

Tire Levers
Cost: $4-10
Purchase at REI

A pair of tire levers are necessary to pry the tire and tube off of the wheel. The tire's bead, its reinforced outer edge, is designed to fit snugly against the inside of the wheel rim. Tire levers give you—no surprises here—leverage to get underneath the bead and shimmy the tire off.

See *Flat tire* for more information on using tire levers.

Allen Wrench Set
Cost: $10-20
Purchase on Amazon

Allen wrenches (also called Allen keys or hex keys) are frequently employed on bicycles, usually when things are secured to the frame (for example, derailleurs). A relatively cheap multitool will give you coverage from around 2mm to 8mm, which should be more than enough. You can also buy them in three-pronged versions that include only the most common sizes.

Open Wrench Set
Cost: $20-50
Purchase on Amazon

If you don't already own a set, open end wrenches are a must-have for bicycle repair. The nuts that secure parts of your bike vary from very small to large, so you'll want as big a range as you can get. The linked 15-piece combination set should account for most situations.

Master Link Pliers
Cost: $10-20
Purchase at REI

These specialized pliers are essential to chain maintenance and replacement for chains that use *master links* to join their separate ends. They are inserted into the space between chain links and pulled together to disengage a specialized link that keeps the chain together. The process is reversed when setting a new chain. While you might be able to get away with needle-nose pliers in a pinch, you'll be grateful to have the real thing in hand when you need a new chain put on quickly.

See *Replacing a chain* for more information.

Chain Breaker Tool
Cost: $10-20
Purchase on Amazon

Chains that don't use master links require chain breaker tools. These work by using a vice to push out a joining pin that connects the two ends of the chain. If you've ever resized a watch bracelet, they work much the same way as those tools do.

See *Replacing a chain* for more information.

Patch Kit
Cost: <$5
Purchase at REI

If you don't want to spring for replacement tubes (which themselves are relatively inexpensive), you can always pick up a patch kit for dirt cheap. They'll pay for themselves if you wind up with a pin-hole or other fixable tear in one of your tubes. For anything bigger, you'll want to replace the tube entirely.

See *Flat tires* for more information.

Cleaning and lubricating a chain

Chains are meant to have a constant layer of lubrication. New chains fresh out of the box are slippery with grease, but after a month or so of regular use (and especially if you're caught in the rain), that brand new chain will start to dry out.

Dry chains don't bend as easily at the hinges between each link. Stiff links can't rotate around the gears and rear derailleur as efficiently. Thus, you end up putting work into the pedals that isn't translated into forward motion: you lose efficiency. Make every joule count by keeping your chain clean and lubricated.

Optionally, pick up a chain wear indicator tool. As chains wear out, the begin to expand and pull apart. If they expand past a certain point, you can experience chain failures, especially when pedaling uphill. These diagnostic aids are just measuring sticks: when you're able to fit their teeth into two links in your chain, it indicates the links in the chain have stretched out, and the chain is past its expiry date.

Make a habit of checking up on your chain regularly, and cleaning it when it gets dirty. Occasionally, you might want to remove the chain completely and soak it in solvent. See *Replacing a chain* for more information.

Tools required:

- Clean rags
- Chain lube
- Degreaser (for seriously dirty chains)
- Old toothbrush (ditto)
- (Optional) Chain wear indicator

Cleaning the chain

1. **Inspect the chain**. Lift the rear wheel off the ground, then run the chain backward by turning one of the pedals with your hand. Look for any links that kink up at the sharp bends of the rear derailleur: these will need special attention. Use a chain wear indicator to determine whether the chain needs to be replaced.

2. **Clean**. Hold a rag over the inside of the chain and pedal backward as before. If the chain is especially dirty and the rag isn't cutting it, spray degreaser into the inside of the chain as you run it back, then attack with the brush.

3. **Inspect again**. Any links still stiff? If so, blast them with degreaser and scrub until they're freed up.

Lubricating the chain

With the chain free of dirt and grime (and your once clean rag now soiled in a more or less satisfying way), fetch the chain lube. First, place a rag on the ground underneath the chain to catch any excess.

Running the chain backward as before, use the dropper to aim lubricant into the inside of the chain links (the outside isn't as important, since the inside is the only part making contact with the gears).

Removing and replacing a chain

Whether removing the chain to give it a deep clean or to replace it altogether, you'll need to learn how to "break" and fix a chain.

Before you jump in, you need to know what tools you need, which depends on your chain. Take a look: does one link appear different from the rest? This is a **quick** or **master link**, and it requires a pair of master link pliers to separate (you might be able to get away with needle-nose, in a pinch).

If you don't see a master link, you will need a **chain breaker** tool. This is a small vise that pushes out the **joining pin**, similar to the other ones that hold chain links together.

Lastly, if you're planning to replace your chain, know that you'll need to know how to cut it down to size. We'll get into this later on.

Tools required:

- Chain breaker tool (if your chain does not have a quick link, or if you need to shorten a chain of any type)
- Master link pliers (if your chain has a quick link)

Removing the chain

If applicable, begin by shifting your rear derailleur to the smallest gear, and your front derailleur to the largest. Once you've figured out what kind of chain you've got (i.e., quick link or traditional), set the bike on its side with the chain facing up, or mount it in a stand.

For master link chains: Place one tooth of the pliers inside the master link and the other in the link adjacent. Push in. The peg holding the link together should also push inward, allowing you to take the master link apart.

For joiner pin chains:

1. Identify the joining pin. It may be a different color, or raised from the chain body.
2. Lay the chain through the outer groove of the chain tool, lining the pin pusher up with the joining pin.
3. Turn the handle clockwise until the pin pusher just touches the pin. Ensure they are aligned.
4. Continue turning the handle until the pin is almost, but not entirely removed from the link. The pin should clear the closer chain-plate (the inner face of the chain, relative to

the pin pusher), and the rollers (between the chain-plates), but it should not clear the outer chain-plate. If you push the pin out completely, it will be nearly impossible to put it back in.

5. Back the pin pusher out of the link by turning the handle in the opposite direction. Remove the chain from the tool.

6. You should be able to shimmy the inner chain-plate and rollers out from underneath the pin. If not, try pushing the pin a little further and trying again.

Sizing, shortening, and replacing the chain

If you're putting on a brand new chain, it'll probably need to be cut to size. Chains typically come with more links than you need: for example, if you ride a fixed gear or single speed, you'll probably have leftover chain that would pass through a rear derailleur. This slack chain can be dangerous, as it risks falling off your bike entirely.

To size the chain:

1. Orient the chain so that the inner master link or the joining pin run forward from the cassette to the chainring.

2. Thread the chain onto the largest gear of the rear cassette.

3. Pull it up and over the largest gear of the chainring. The joining pin or inner master link should hang down from the chainring.

4. Pull the two ends together at the bottom, as close as they can get. There will be overlap: let the end with the joining pin or inner master link touch the teeth of the chainring, while the excess of the left end hangs down.

5. Two links will touch, with the left end hanging additional slack. You may not be able to join the two closest available links, as they might have the same orientation (the chain-plates must be opposite). Count out to the closest compatible rivet, then count two rivets further: this is the pin you must push to cut the excess chain. Mark it or otherwise keep note of it for later.

6. Break the chain at the marked pin using the chain breaker tool, as described in the previous section.

7. Use the chain breaker tool to push the joining pin through the newly opened link, or use the quick link pliers to pull the quick link outward into a locked position. Make sure to practice proper chain care to mitigate wear.

Removing and replacing a wheel

This will be required to accomplish many of the other maintenance items included in this guide.

Tools required:

- 15mm wrench. This is the most common size for axle nuts, but yours may vary. If your wheels have a quick-release lever, you won't need this.

Removing the wheel

Begin by mounting the bike on a stand. If you don't have a stand, lay the bike on its side. Assuming your derailleur is on the right, this will mean laying it on its left side.

1. **Disengage the brake quick release, if you have the option**. You will need your brakes to be in as wide a position as possible to fit the rim through. Your brake levers, or the brakes themselves, may include a quick-release feature.

2. **Prepare the wheel for removal from the frame:**

    - **If your wheel has a quick release:** Flip the lever open. Holding the opposite end of the skewer in place, unscrew the quick release nut slightly.

    - **If your wheel has a solid axle:** Use the wrench to unscrew both axle nuts slightly.

3. **Pull the wheel out of the dropouts**. This might require some finagling to negotiate the brake calipers. If removing the rear wheel, give the chain some slack by pulling down on the rear derailleur.

Replacing the wheel

It's important to replace your bike's wheel with care. If it's not secured properly, it may not be safe to ride.

1. **Slot the wheel back into the dropouts.** Seat the axle firmly in the fork. It may help to stand the bike up to do this. If replacing the rear wheel, pull down on the derailleur again and thread the chain over the cassette. Ensure the rim of the wheel is seated between the brake pads.

2. **Tighten the quick release or axle nuts.**

    - **If your wheel has a quick release:** Tighten the quick release nut as much as you can while giving it enough space to close. If you tighten it too much, you won't be able to clamp the lever down. Make sure the closed lever position points up and

forward: leaving the lever facing down risks collision with objects that might cause it to disengage.

- **If your wheel has a solid axle:** Use the wrench to screw down both axle nuts slightly.

3. **Check to see that the wheel is centered**. If the wheel leans to the left or right inside the fork or frame, loosen the nuts or disengage the quick release and realign, then retighten.

4. **Re-engage the brake quick releases**. Nudge the brake pads left or right as needed to center them over the wheel.

Take the bike for a test ride away from traffic to ensure nothing is loose.

Flat tires

You hear the dreaded *pop*. You look down and see a limp tire dragging uselessly on the ground. You've got a flat. Fear not: replacing a punctured tire, or the air-filled tube inside, couldn't be simpler.

Tools required:

- Pump
- Spare tube and/or tire, depending what's punctured
- Tire levers

Step One: Removing the wheel

Refer to **Removing and replacing a wheel** for this step.

Step Two: Removing the tire and the tube

Lay the tire out on a bench or on the ground, with the cassette pointing up.

1. With the flat end pointing toward the inside of the wheel, wedge a tire lever between the rim of the wheel and the bead of the tire. Push the lever up to create some distance between the tire and the wheel.
2. Insert another tire lever a few inches to the left or right of the first and repeat.
3. Walk the second tire lever around the wheel. As you go, the bead should sit outside the rim of the wheel.
4. Find the valve stem of the tube (it sticks out from the inside of the rim) and pull it out. Pull out the tube from the tire. Leave the tire as is, with one bead in and one bead out.

Step Three: Finding the leak

The leak could be on the tube, the tire, or both. You'll need to identify the source and the cause to determine what to replace.

1. **Inspect the tire.** Look for obvious exterior damage, protruding nails, etc.
2. **Inspect the tube.** Tube damage can be harder to locate. If not immediately apparent, spray the tube in soapy water and inflate. Look for bubbles caused by escaping air.
3. **Inspect the rim.** If you don't see an obvious cause for the puncture, or if the puncture is on the bead or the side of the tube, the flat might have been caused by a pinch from

the wheel's inner rim. Run your fingers lightly around the inside of the wheel's rim, feeling for burrs or other sharp protrusions. If you find any, try filing them down to prevent another flat.

Step Four: Patching or replacing

A damaged tire will usually need to be replaced, as friction with the road will remove any patching.

A tube with minor, pin-hole damage can be patched (see Patch Kit). Larger gashes or damage near the valve stem will require replacement. When replacing the tube or the tire, look for their dimensions embossed on the surface.

Patching the tube:

1. Follow all instructions in the patch kit.
2. Clean the surface of the tube.
3. Abrade the surface around the puncture with sandpaper. This gives the patch more surface area to adhere.
4. Apply the kit's glue to the puncture. Let sit as directed.
5. Apply the patch to the tube as directed.

Replacing a tire:

1. Remove the damaged tire by pulling the remaining bead off.
2. Insert one bead of the new tire into the rim.
3. Follow the next steps to insert the tube.

Step Five: Insert the tube into the tire

1. Use the tire pump to inflate the tube slightly to give it shape. This makes it easier to insert under the tire.
2. Line the valve stem up with the hole in the wheel and insert. Walk the tube underneath the tire to the right and left.
3. Using your thumbs, push the exposed bead under the rim of the wheel, walking up from both sides to a single point. This may become difficult near the end: use a tire lever to finish the job.

4. Fill the tube slowly, listening for the sound of any unidentified leaks. Continue inflating to the recommended tire pressure (usually printed on the tire itself).

Step Six: Replacing the wheel

Refer to **Removing and replacing a wheel** for this step.

Conclusion

There's nothing quite like the vestibular motion that comes with a bike ride, the world whipping by and the air fresh and sharp to your senses. Whether the bicycle for you is a tool for getting from point A to point B or a way of life, you can only be served by cultivating a deeper understanding of its history, its makeup, and its maintenance.

For my own part, I've commuted to my workplace in New Haven, Connecticut for the past two years, and in that time have had to fix almost every part—at one point, the entire bike. I wanted to share some of the tips and tricks I'd picked up from others in the community, so I created this guide. I hope this guide has given you an appreciation for the most popular vehicle in the world. If you have any feedback, please let me know at cycling.ethan@gmail.com. I'd love to hear from you!

Happy Cycling!

Explanation of Updates

Miscellaneous changes:

- Fixed leading spaces on some bullet items (as mentioned in feedback for Lesson 3)
- Added captions for images that aren't explicated by in-image text.
- Added buffer space below heading styles.
- Unbolded brown H3 style for quicker visual distinction against grey H2.
- Changed conclusion email to dummy address.
- Removed blank page.
- Added further reading to History section.
- Added "Flat tires" procedure.

Documentation Review Checklist				
Document Title: Bicycles 101: Repair and maintenance for beginners		**Review Date: 2/10/23**		
Section	**Item**	**Y**	**N**	**Comments/Changes**
Front Matter/ Overview	The title page includes required company information (e.g., logo, company name, project and document title).	X	☐	
	The purpose of the document is clear and complete.	X	☐	
	All known audiences/customers/users are described thoroughly and accurately.	X	☐	Title "101" implies introductory nature; introduction calls out guide as being for beginner.
	The scope of the document is accurate and complete.	X	☐	Added disclaimer in introduction that narrows scope to road bikes (earlier version made promise to address as many types of bike as possible for all procedures… that came to be an unrealistic goal for this project).
	Product version numbers and release dates are accurate.	X	☐	Added version number & date.
	The table of contents reflects correct page numbers and section names.	X	☐	Added table of contents.
	All steps in the procedure are accurate and complete. (For short procedures.)	X	☐	

Procedure/ Body Text	-or- Step 1 text and screen shots are accurate and complete. (For lengthier procedures and corresponding screen shots.)	☐	☐	N/A
	-or- Section 1.1 text is accurate and complete. (For sections of body text that are not broken into steps.)	☐	☐	N/A
	All corresponding screen shots accurately display the current version of the software/clearly relate to the step text.	☐	☐	N/A
	All charts, graphs, and diagrams are labeled accurately and consistently.	X	☐	
	All sensitive or proprietary data has been redacted or masked.	☐	☐	N/A
	All safety, privacy, and/or other details are specified.	☐	☐	N/A
Copy Review	Company-specific product names and industry terminology used consistently throughout the document (e.g., proper nouns capitalized).	X	☐	
	Acronyms are spelled out completely in the first instance.	☐	☐	N/A
	All hyperlinks have been tested and work.	X	☐	
	The document flow and structure logical for the audience to follow.	X	☐	Section flow: Intro > History > Bike anatomy > Parts required > Maintenance > Conclusion Intro + history give reader context; Bike anatomy gives reader foundation for the items that will need to be worked on; tool shopping list required before maintenance that uses those tools
	Spelling and grammar check are complete.	X	☐	
	The document text is concise and clear.	X	☐	Every effort made to keep sentences short & to-the-point. New terms are explicated whenever introduced for the first time.

Standards and Style Review	Header contains standard information (e.g., logo, document title).	☐	☐	N/A
	Footer contains standard information (e.g., confidentiality statement, page number, date).	X	☐	
	Headings match standard font, color, size styles.	X	☐	
	Body text matches standard font, color, size styles.	X	☐	