



**Miniature Guide to Bike Repair**

## What's this booklet all about?

Hi, my name is Jameel. I am a volunteer at a community bike project in Washington, DC called the Bike House. The mission of the Bike House is to create a place for all people to work on, learn about, and enjoy bikes.

I believe that biking is a fun and convenient way to get around. I love parking right in front of my destination every time I go somewhere. I love never having to worry about missing the last subway. I love never stopping at the gas station. I love passing by traffic jams. I love feeling the thrill of pumping up a big hill and breezing down the other side.

Biking is my choice for adventuring. I love riding all day on the open road, with no concerns but where to make dinner and where to spend the night. You can see your state, or the country, or the world, all from your bike seat. If you ever have 3 months to spare, you really must ride across the country. You won't regret it.

I also am a strong believer in the do-it-yourself ethic. Being able to fix it yourself, modify it yourself, build it yourself from scratch... all on a shoestring... that is what pushes bikes from a mode of transportation to a truly fulfilling pastime for me. If you are a person who gets fulfillment from this kind of independence and knowledge, bikes are for you. But you already know that, which is why you are reading this.

Bikes are simple enough that every rider can master a few skills that will keep you riding and happy. Can you use a clothes dryer without knowing how to empty the lint trap? Yeah, for a while you can, but you are asking for trouble. It's the same thing for oiling a bicycle chain, patching a tube, adjusting your brakes, and changing a spoke. That's what you can expect to learn here.

Happy wrenching!

## Resources

The best way to learn how to fix bikes is to buy an old used bike and go about replacing the broken parts on it, forcing yourself to learn as you go. In addition to asking the experts and reading this little manual, there are a myriad of resources available. Some of our favorites:

### Books.

**Zinn and the art of road (or mountain) bike maintenance.**

**The Chainbreaker Bike Book.** Rough DIY guide written by hip folks from a bike co-op in New Orleans.

### Websites.

**Sheldon Brown** – Extremely quirky and entertaining mechanic who trolled the forums helping everyone with a keyboard fix their bike (now deceased, but still loved). <http://www.sheldonbrown.com/>

**Park tools.** Seller of fine bike tools, also with a useful online resource for bike repair. <http://www.parktool.com/repair/>

## Fix a Flat

You will get a flat tire sometime. Do you want to walk to the nearest bike store, or do you want to spend 15 minutes fixing it right where you are, and be back on the road? I don't personally carry a patch kit and pump everywhere I go, but I do carry them if I am going on a day ride or a tour. Since I got tough tires that rarely get flats, I almost miss them.

To fix a flat, you need some basic tools: a patch kit, tire levers, and a pump (and a crescent wrench if you don't have quick-release wheels). This is the basic toolset anyway.

Remove your wheel. The easiest way to work on your bike is by flipping it over and setting the bike on the seat and handlebars. To get the wheel off easily, you often need to disconnect your brakes or turn a quick-release on your brakes.

Pry. Empty the air out by pressing on the air valve. You need to get one side of the tire bead out by prying it open with plastic tire levers (not metal, so you don't further damage the tube). I usually get two in side-by-side, and then slide one around to get the tire halfway off, but sometimes three are necessary. At this point, you can pull the tube out.

Be a detective (with both tube and tire). You need to find the hole (or holes). So pump some air into the tube and slowly listen to different areas of the tube, listening for the hiss of air and trying to feel where the air is blowing out with your cheek. You also need to feel the inside of the tire to make sure whatever punctured the tube in the first place isn't still there.

Patience is a virtue! The instructions are in your patch kit, but what they say to do is 1) roughen up the spot with sandpaper, 2) apply some glue or vulcanizing fluid, 3) be patient for 5 minutes, and 4) apply the patch thoroughly. The number one step that gets messed up is the five minute wait. I have had to patch twice a bunch of times because I rushed this.

Carefully get the tube back in place. If you pinch the tube while forcing the tire back on, you might be back to square one. The same thing can happen while pumping up the tube.

Finally, carry a spare tube in case the patching gets frustrating for some reason, or the hole is really large.

## Clean and lube your chain!

If you've ever been stymied by a rusty chain, it was partially because your bike was out in the weather, but partially because you didn't lube it frequently enough.

Clean your chain, but not too much. Cleaning can be as simple as holding a rag over your chain and spinning the pedals. Or spray a little with a hose. You could even go as far as using some household soap. Use something gentle, though. The goal is to get dirt and grime off the outside while leaving any remaining lube on the inside. It's not necessary to remove the chain and soak in degreaser.

One drop at a time. Once cleaned, it's time to lube the chain. The really meticulous mechanic would go through and apply a single drop of lube to each chain link. That takes patience. I usually end up spinning the chain while applying a stream of lube. Stop once you think you've gotten some lube on all the links.

Clean up afterwards! Especially if you used the "stream" method, you've got way more lube on your chain than you need. Any lube on the outside of your chain will only pick up dirt. It's the lube on the inside of the links that is doing its work. Wipe off any excess lube off the outside with a rag.

What lube to use? I don't have a strong opinion on this. Anything marketed as chain lube is probably great, whether "wet" or "dry" styles. Tri-Flow is a good, and common product. Just don't use bearing grease. And really don't use WD-40 (this is more like soap than it is like oil - quickest way to rust your chain is to use WD-40).

How often to lube? Most bike mechanics books might say you need to do this every few weeks, but many cyclists have never ever done it. I say split the difference and clean and lube your chain a few times a year. More if you ride all the time in the rain (the rain is washing away your chain lube).

## Essential Toolkit!

You can do everything in this little manual with a toolkit small enough to take on a self-supported bike tour. I recommend that you buy these tools. The last four have a star. You could claim these ones aren't the bare essentials, but they are still totally worth it. Especially for the budding bike mechanic.



Allen key set. Get a seven-in-one metric fold up allen key set from a bike store -- that way it will be metric (pretty much all bikes) and focus on the relevant bikes sizes.

Screwdriver. I like the four-in-one variety. Sometimes you want big, sometimes small! (almost always phillips, however)

Crescent wrench. Medium size, big enough to fit around your cassette removal tool.



Tire levers. Plastic are better. You need at least 2, and they usually sell three together.



Patch kit. Includes patches, glue / vulcanizing fluid, and sandpaper.

Bike pump. Patching a tire is great, but you also need to pump it up!

Chain lube. Own it or you won't use it. And your chain will be rusty.





Cassette removal tool. Got to match it to your bike. Necessary the first time you break a spoke on the drive side of your back wheel.



Mini vise-grips. Ideally, you never use vise-grips. In reality, they do the job of the tool you don't own yet. Notable here, they pull cables.



Chain whip / pedal wrench.\* Chain whip makes getting your cassette off a lot easier. Pedal wrench allows you to stow your bike in a shipping box or car trunk without the pedals sticking out, or to switch to those schmancy clip-in pedals.

Chainbreaker.\* After you ride 2,000 miles, you'll want to change your chain, and this tool will be necessary.



Spoke wrench.\* You could get by removing the tire and using a screwdriver in the top of the nipple, but this makes things a lot easier.



## Adjust your brakes!

Brakes function by the brake lever pulling a cable, which pulls the calipers closed. To see this in action, use your hand to pull an exposed bit of the brake cable, and watch the calipers close.

If the brakes are well adjusted:

- braking will be effective
- levers won't hit the handlebar
- brake pads will be close to the rim (without hitting it)

Brakes tightness can be adjusted two ways:

1. Barrel adjusters (fine adjustments)
2. Cable anchor bolt (large adjustments)

A barrel adjuster works by a hand-adjusted nut. Turned "lefty-loosey", the barrel adjuster gets longer. Since the cable runs through the barrel adjuster, and the cable remains the same length, lengthening the barrel adjuster is like tightening the cable. (try it each way to make sense of this)



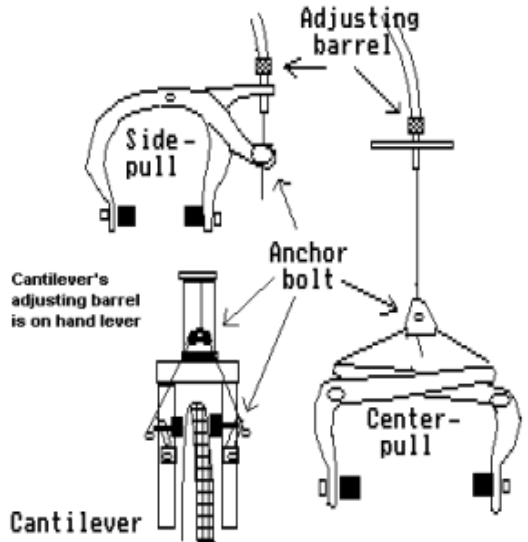
Ideally, your cable is positioned in such a way that you never need to clamp and unclamp your cable. As your brake pad wears, it gets thinner, which means you will need to tighten the cable (by extending the barrel adjuster). When you get around to replacing your brake pads, they will hit the rim (since they are so much thicker than your old worn-out pads) so you will need to loosen the cable (by shortening the barrel adjuster).



It is better to avoid clamping and un-clamping your brake cable because it creates a little kink, which is a weak point. If that weak point is in between the brake lever and the brake caliper, you raise the chance of sudden brake failure (super dangerous).

If you do need to un-clamp and readjust your brake cable, either a vise grips or fourth-hand tool is necessary to pull the cable. Also keep in mind how worn your pads are so that you can position your cable so you won't have to move it again.

A third common type of adjustment is side-to-side. If one brake is rubbing while the other is far from the rim, you need to change that! Some brakes have tiny little bolts to adjust this very thing, called



“spring tension centering screw” in the diagram below. The bolts push on springs, so it is a matter of balancing the spring tension between the left and right sides. Older brakes don't have this adjustment, and you need to loosen the entire brake



caliper and tighten it right in the middle, which is really tough.

# Inspect your bike!

## Tires:

- Are the tires pumped up?
- Are the tires in good condition?

## Chain/Sprockets:

- Is the chain rusty / has it been oiled lately?
- Are the sprockets noticeably worn out?

## Brakes:

- Are the brake pads reasonably close to the rim?
- Are the pads aimed at the rim and not the tire?
- Do the wheels spin without hitting the brakes?
- Are the brake pads worn out?

## Other stuff:

- Are any of the cables dislodged?
- Are the cables rusty? Do they move smoothly?
- Is any of the cable housing cracked?
- Does the headset or bottom bracket move?

## Test Ride:

- Is the brake action effective?
- Do the gears change smoothly?
- Can you get to all the gears?
- Are there funny noises?

## Fit:

- Are the brake levers positioned comfortably?
- Is your leg extending nearly all the way but not locking?
- Are all the hand positions comfortable?



Chain on edge of being rusty



See how pad is lined up with rim?



Left: leg locked out (bad),  
Right: good



If you can see cracks in the side of the tire, or the tread is all gone, time to replace



When sprocket gets worn, the teeth look shiny and sharp. This is a way extreme case, actually from a motorcycle



Bottom bracket shouldn't wiggle, just spin

## Change your brake pads!

There comes a time when adjusting your brakes is not enough, and changing the pads is what stands between you and effective braking. Which is okay, because pads are cheap and easy to switch out.

There are different designs. Make sure to look at what you have on the bike before buying new pads. As you take the pads off, remember to watch the ordering of the washers and whatnot. I can't promise they all go on the same way.

What's with those crazy washers? A lot of brakes use crazy curved washers. They are curved in such a way that you can adjust the brake pad to be pointed in different directions, and then tighten it wherever you want. This means that they help adjustability. Also, there are often different width washers, which you can switch around if you need to move the pads closer or further from the rim.

Make sure to aim 'em right. The main challenge when installing new brake pads is getting them so that they are aimed correctly at the rim. You want the pad exactly in line with the rim, not touching the tire above, and not missing the rim below. This is especially difficult because when you tighten the bolt, it tends to swivel the brake pad. A good trick is to hold down the brake lever hard to clamp the brake pads against the rim while you tighten the bolt. The friction keeps it in place a little better, but it is often still necessary to have a friend hold the brake pad in place as you tighten.

What about toe-in? Toe-in is the great mystery of brake pad alignment. Sometimes I bother, sometimes I don't, and it seems to work out either way. Toe-in means that the front of the pad hits slightly before the back end of the pad. The logic is that since the wheel is turning, it pushes the brake pads to the side when you brake. You want them tilted slightly so that as the wheel pushes the pads sideways, it increases the braking surface. To achieve toe-in, tie a rubber band or something around the back part of the brake pad, and then do the same as before.

## Adjust your limit screws!

Have a jumpy chain? Sometimes the way to fix it is to adjust the limit screws on your derailleur. Both your front and rear derailleur have (among others) two little screws next to each other, sometimes with an "H" (high) and "L" (low) markings. These screws define the upper and lower limits to which your derailleur can move.

To see the limits in action, pull an exposed section of the derailleur cable. Assuming your chain isn't getting in the way, at some point the derailleur will come up against an upper limit beyond which no pulling is possible. It's harder to see the lower limit in action. To do so, you have to create slack in the cable, and you will see the derailleur rest at the lower limit.

Set your limits right. If the limits are too expansive, normal shifting can swing the chain off of the sprockets. This is especially bad in the back, because the chain can get stuck in between the cassette and the spokes, and end up damaging a bunch of spokes. The right adjustment allows you to access all the gears, but no further. Keep tightening the limit screws and then testing if you can still access all the gears (either with shifting or just using your hand to pull the cable).

Minimize pressure while you adjust. If you are in the smallest chainring, and you adjust the lower limit screw, you might see the derailleur moving. It's nice to have such immediate feedback, but you should avoid this situation because you are causing unnecessary pressure as you adjust. It will make the screw strip easier, and it's more difficult to turn. Better is to switch into the middle gear as you adjust the limits, and then test. Adjust, test, adjust, test, etc...

## Change your broken spoke!

Behind flat tires, I think a broken spoke is the most likely thing to sideline you on a long tour. I consider it a key skill to learn, and will introduce you to one of the holy grails of bike maintenance, wheel truing.

Say you're biking along, and suddenly you notice that biking is way harder than it was a minute ago. Your rim is hitting your brake pads, or maybe even your frame, slowing you down. First thing to check is that your wheel is well-seated, but if that turns out not to be the problem, you probably broke a spoke, which has changed your wheel from a perfect circle to something else.

You need a spoke within a millimeter of the length of your old spoke. This is complicated, because you actually may have as many as three different spoke lengths on your bike (front wheel, back wheel drive side, back wheel non-drive side). A bike shop should be able to give you the right one.

Thread your spoke. Make sure to thread or route your new spoke the way the old one was. Examine the other spokes on the wheel, and make sure the new one doesn't mess up the pattern. The most common pattern is "cross-three" which involves passing spoke over two adjacent spokes, and then under a third.

Twist the nipple. Okay, that was a little gratuitous. The spoke nipple is the little thing at the rim that the spoke threads into. Two ways to tension your new spoke -- one is to take off the tire, tube, and rim tape, and use a screwdriver from the outside. The other is to use a spoke wrench (make sure you have the right size to avoid rounding over the nipple). If you use a spoke wrench, all the usual "righty-tighty, lefty-loosey" will be reversed. This is because you are looking at it from the bottom. If you took off the tire, tube, and rim tape and used a screwdriver on the outside, everything would seem normal.

The goal: try to match the approximate tension in your new spoke to the tension of other spokes in the wheel. You can squeeze pairs to test the tension. When you do this, it will eliminate the wobble in the wheel and you will be back to a perfect circle. If you notice you have lots of spokes of wildly different tensions, or your wheel wobbles all over in lots of different places, think about exploring wheel truing a little further.

## Remove your cassette!

If the spoke you broke is on the back wheel on the drive side, then before you can get to it you will have to remove the cluster of gears on the wheel, called the "cassette" or "freewheel" or "freehub" depending on the type you have. This takes two special tools: a chain whip and a cassette removal tool (which is different for different brands, but many are Shimano-compatible).

Engage your cassette removal tool. After removing your quick-release or axle, you should be able to fit the cassette removal tool into the middle of the cassette. Try turning it "lefty-loosy" and you will see why the chain whip is necessary: free backspin.

Hold with the chain whip.\* Arrange the chain whip so that it is braced against the cassette turning counter-clockwise. This involves the long part of the chain around to the right (pictured).

Crank it. Reinstall the quick-release over the cassette removal tool to hold it in place, then turn it with a crescent wrench. After a turn or so, it will be loose, and you can do the rest by hand.

\* It is definitely possible to get by without a chain whip, but it is also hard. You would need to use the chain of your bicycle. If you have a foolproof system, I'd love to hear it. Also there are travel-size tools, but they seem like they put a lot of pressure on the bike.

## Technical parts of a bicycle.

Please note not all parts appear on all bicycles.

