

DIY Smart Dissecting Microscope (Smart-D-Scope) !

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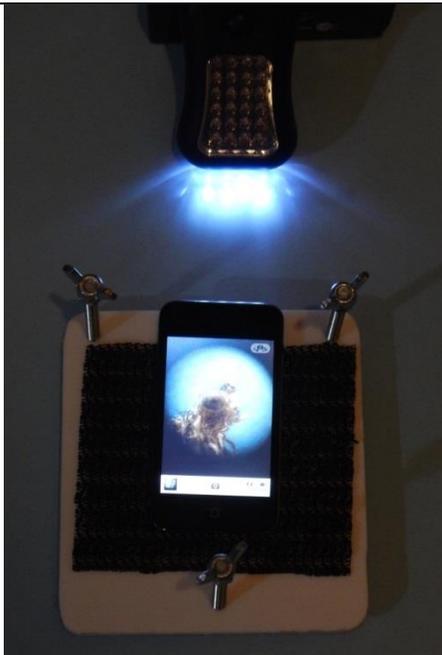
Use your smart phone/iPad/iPod Touch as a dissecting microscope and camera!

New & Important Construction Note !!!

A maker who used the previous set of plans suggested that a three leg platform would be easier to focus. It is! The plan for the HDPE Smart D Scope shows a layout for the three leg model and a four leg model (see page 4). Any of the plans shown here can be modified for a three legged version. The plans can also be customized for the dimensions and lens placement for your own smart phone/iPad/iPod.

A low-tech easy-to-build platform can be used in combination with a smartphone, iPad, iPod Touch, or similar electronic device as a digital dissecting microscope and camera. The lens for the platform cost just \$1.00. The entire device can be built for around \$7.00.

These plans will allow you to build a smart microscope platform that you can use to magnify and photograph a small portion of a large surface that normally cannot be viewed under a dissecting microscope (such as; a tool mark on the hood of a car, scoring on an engine's crankshaft, the end of a large bone). These plans also allow you to change the focal plane from the horizontal to view irregular surfaces and objects. Two types of Smart-D-Scope plans are detailed below: the thin panel, and the threaded HDPE versions. Both accomplish the same task. Each plan requires different materials, hardware, and tools to build. When name brands are used in the directions below, they are for illustrative purposes only and are not a product endorsement. Since the focal length of the lenses is only about 3/8", construction materials more than 1/4" in thickness will not allow enough room for the sample and adequate space for illumination.



A 3 leg Smart D Scop with an iPod 3 (above) shows the eye of a caddisfly on the screen illuminated by a LED flashlight.

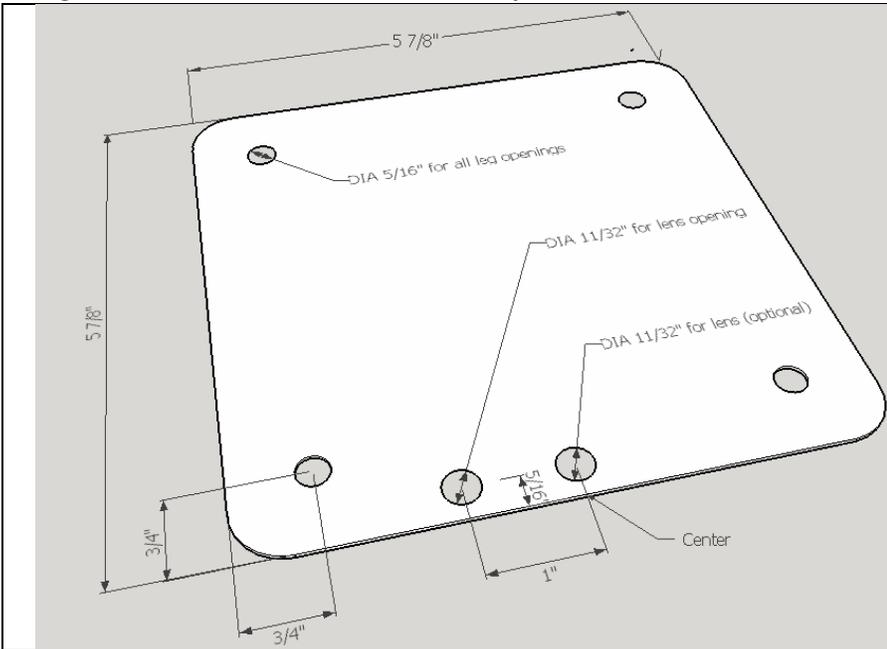
The caddisfly eye in the image above, was taken with the setup shown on the left.

Thin Panel Smart-D-Scope



The pictures above show the top (left) and the bottom (right) of a Thin Panel Diamond Plate Aluminum Smart-D-Scope. Hardboard 1/8" thick as well as other thin rigid thin sheet materials can be used. Note that the clips are installed with the threaded portion on top. This allows for a greater range for focus adjustment than if the threaded portion was placed face down.

Drilling Plan for the Thin Panel Smart-D-Scope



Layout pattern of drilled holes for the thin panel Smart-D-Scope. *A different plan shown on a following page is needed for the HDPE plastic base scope.*

The actual size of the bases may vary from these dimensions. Clipboards can even be modified to be used with iPads! However the location of the holes for the clips from the outside edges, need to match the depth of the throat of the clips. The location of the lens may need be adjusted to match the lens location on your smart phone. A number of phones place the camera lens along the centerline of the device.

Drill the holes as shown on the plan. The adjusting screws on the thin panel Smart-D-Scopes are held in place with U-Nuts. U-Nuts are commonly used in cars to attach trim and accessories to sheet metal panels. You can purchase them at most auto parts stores. The specifications for the U-Nuts that are used here is that they work on panels that range from .025" - .15" in thickness. The center of the hole in the nut is 25/32" from the edge. Good results were obtained when the holes were placed 3/4" from the edge.

Be careful when drilling the holes into the panels. Metal and plastic panels can catch and spin when being drilled. To avoid this, clamp your work in place or use a jig that will prevent spinning. See below for final assembly and use directions.



U-Nuts, Body Nut

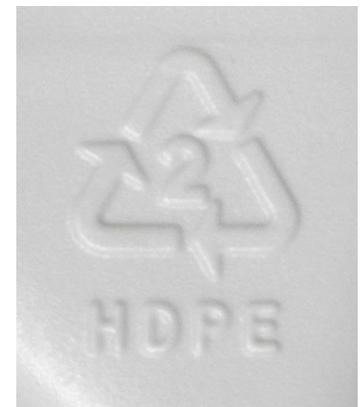
Plastic ¼" HDPE Plastic Smart-D-Scope

A ¼" (or 0.22") HDPE sheet can be used to make a Smart-D-Scope. Drill the holes as shown on either the three leg or four leg plan. Threads for ¼" carriage bolts are made in the drilled holes with a tap held in a handle made for this purpose. When starting to tap a hole it is important to hold the tap perpendicular to the surface being tapped and press down while you turn the tap in a clockwise direction. When tapping aluminum or steel it is important to use a cutting oil to lubricate the tap. Oil is not necessary when tapping HDPE.



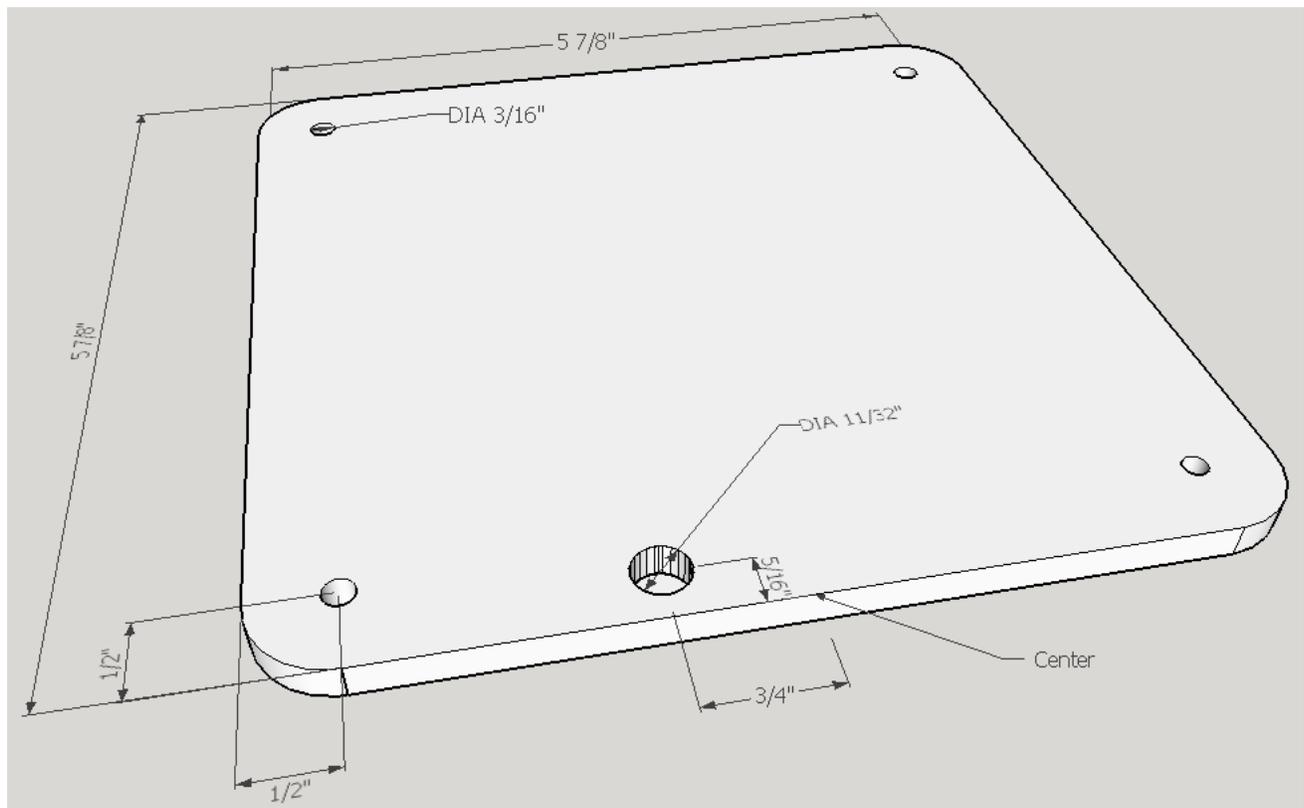
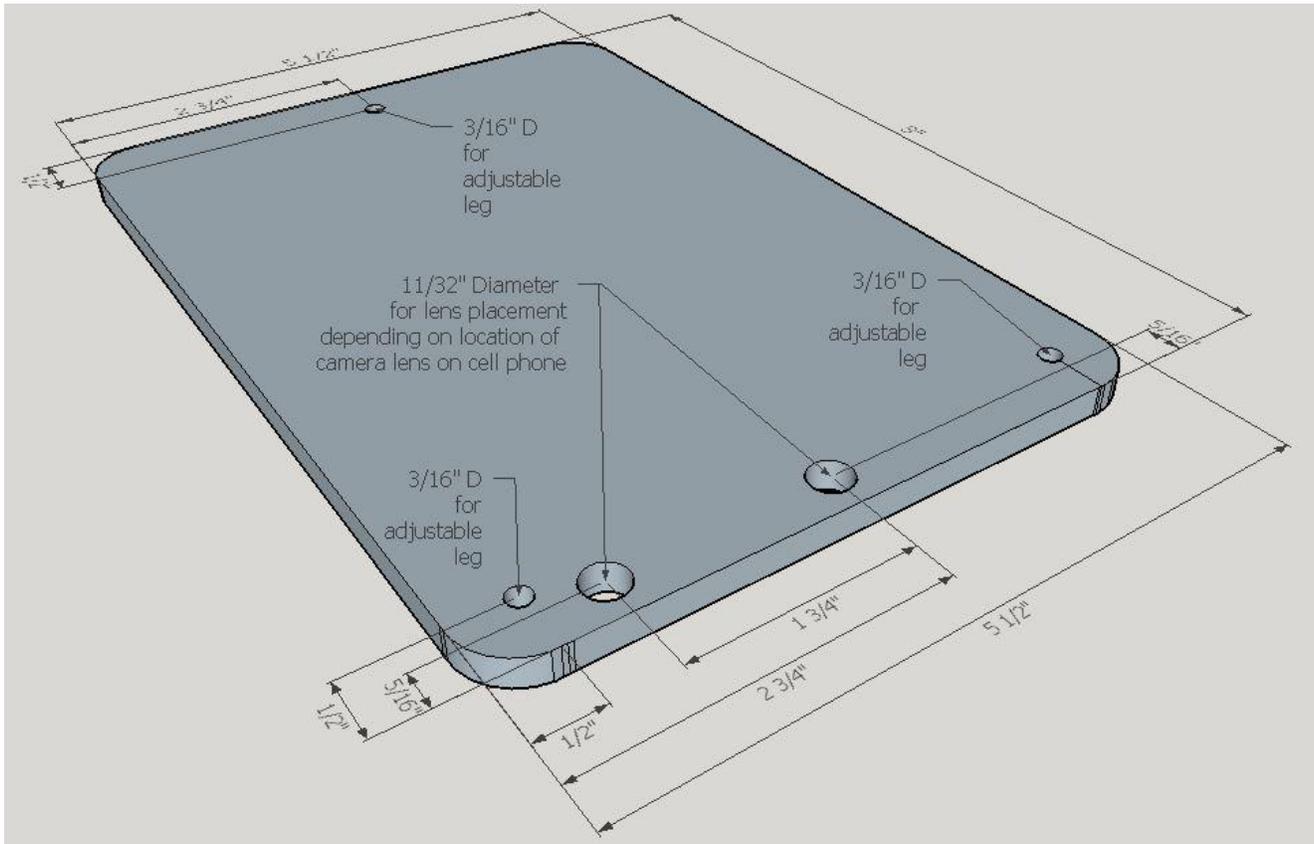
Recycled ¼" HDPE Plastic Smart-D-Scope

High-density polyethylene (HDPE) is a polyethylene thermoplastic commonly used in the production of plastic bottles, and plastic lumber. HDPE is commonly recycled, and has the number "2" as its recycling symbol. It can be easily cut with a circular saw and drilled with regular drill bits. It can be purchased from a number of plastic supply companies. However, small odd sized leftover pieces are usually available on eBay.



Drilling Plan for the Recycled 1/4" HDPE Plastic Smart-D-Scope

Shown below are two possible layouts for a Smart D Scope. The first one shows a 3 leg layout made for a friend's Samsung Galaxy Note. The second plan is for a 4 leg Smart D Scope



Final assembly instructions

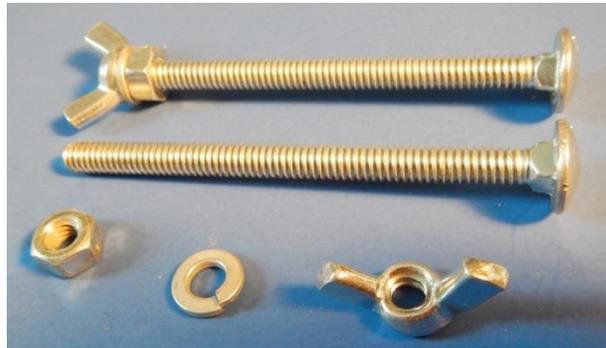
The lenses used to turn the platforms into microscopes are pushed into the 11/32" holes. Make sure that the small opening of the lens faces your cell phone. (The smaller opening is shown in the bottom row of lenses in the image to the right.) You will have to push hard to get the lens into the hole. If you have difficulty pushing them in by hand, you can put a piece of softwood over the top of the lens and tap the wood with a hammer. These lenses were purchased from AixiZ Service & International, LLC. The lenses can be ordered on-line at:

http://www.aixiz.com/store/product_info.php/products_id/375.

If you find that the hole you have drilled is a little too large, wrap the threads of the lens assembly with masking tape to fill the void.



The next step is to install the 3 or 4 carriage bolts into the threaded portion of your platform assembly with the rounded head pointed in a downwards direction. A hex nut is threaded onto the end of the carriage bolt about 1/2" from the end. Then place a lock washer, followed by the wing nut. Use a wrench to tighten the nut so that it fully compresses the lock washer. (The bottom row in the image to the left (from left to right) shows a hex nut, lock washer, and wing nut. The top row shows how they are assembled without showing the platform.) You are ready to use your microscope!



If indoors you will need a light to illuminate your sample. I often use a small LED flashlight on a ring stand or held in place by a cardboard stand. If your image looks washed out, position the light further away from the sample and scope. The focal length of this assembly is approximately 3/8 of an inch. Adjust the carriage bolts by turning the wing nuts to raise and lower the scope.

The portability of these scopes and the accessibility of this technology make it easy to collect and photograph samples of interest far from a lab.

A thin piece of cushioned gripping shelf liner can be used under your smart device to prevent it from slipping on the Smart-D-Scope platform.

Parts Lists

Thin Panel Smart-D-Scope	HDPE Plastic Smart-D-Scope
Thin panel hardboard, aluminum, steel, etc. 5 7/8" square or sized to fit	1/4" Recycled HDPE Plastic 5 7/8" square or sized to fit
Lens suitable for small laser	Lens suitable for small laser
(3 or 4) U-nuts with 1/4"-20 thread	-----
(3 or 4) 1/4"-20 x 3 1/2" carriage bolts	(3 or 4) 1/4"-20 x 3 1/2" carriage bolts
(3 or 4) 1/4"-20 hex nuts	(3 or 4) 1/4"-20 hex nuts
(3 or 4) 1/4" split ring lock washers	(3 or 4) 1/4" split ring lock washers
(3 or 4) 1/4"-20 wing nuts	(3 or 4) 1/4"-20 wing nuts
Optional –gripping shelf liner	Optional –gripping shelf liner

Tools Lists

Thin Panel Smart-D-Scope	HDPE Plastic Smart-D-Scope
Drill	Drill
Drill bit 5/16"	Drill bit 3/16" or #7
Drill bit 11/32"	Drill bit 11/32"
Hammer with scrap block	Hammer with scrap block
7/16" wrench or adjustable wrench	7/16" wrench or adjustable wrench
	Tap handle
	1/4" -20 tap

Inspired by the Instructable: [\\$10 Smartphone to digital microscope conversion!](http://www.instructables.com/id/10-Smartphone-to-digital-microscope-conversion/) by Yoshinok

<http://www.instructables.com/id/10-Smartphone-to-digital-microscope-conversion/>



The image on the left shows a “Larry” LED flashlight held in a lab stand by a test tube clamp. The flashlight is illuminating the denim jeans. The image on the iPod shows the threads of the fabric. The stressed threads show the white inner core of the thread.