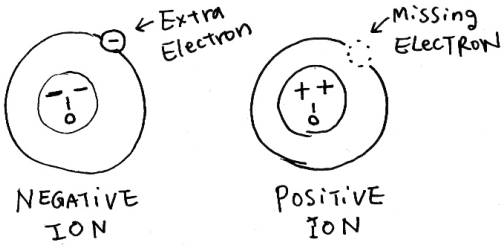
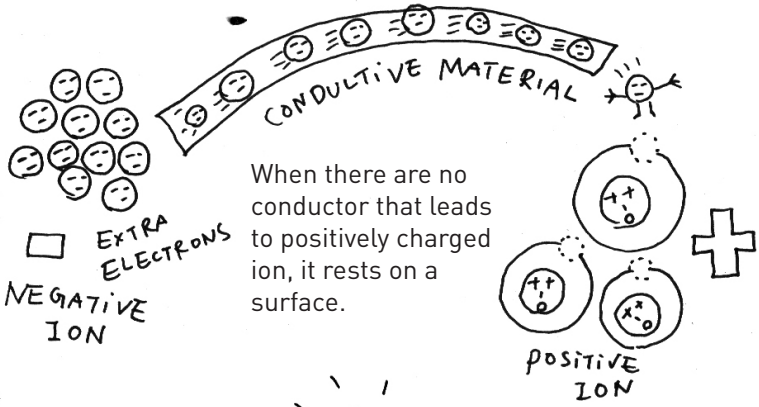
Soft interactive TECHNOLOGY e-Textile HANDBOOK

What is ELECTRICITY

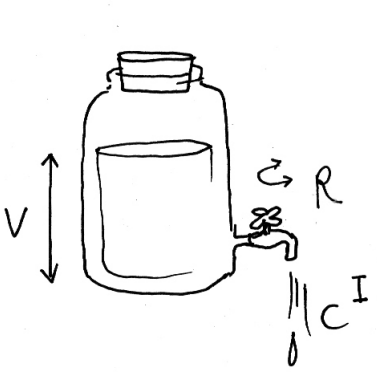


Atoms are made of electrons, protons and neutrons.
Electrons have a NEGATIVE electrical charge, while protons have a POSITIVE electrical charge and neutrons have no charge.

Free electrons can move at hight speed through metals, gases and a vacuum: conductors. It moves form negatively charged ion to positively charged ion and fills the missing electron.



When there are no conductor that leads to positively charged ion, it rests on a surface.

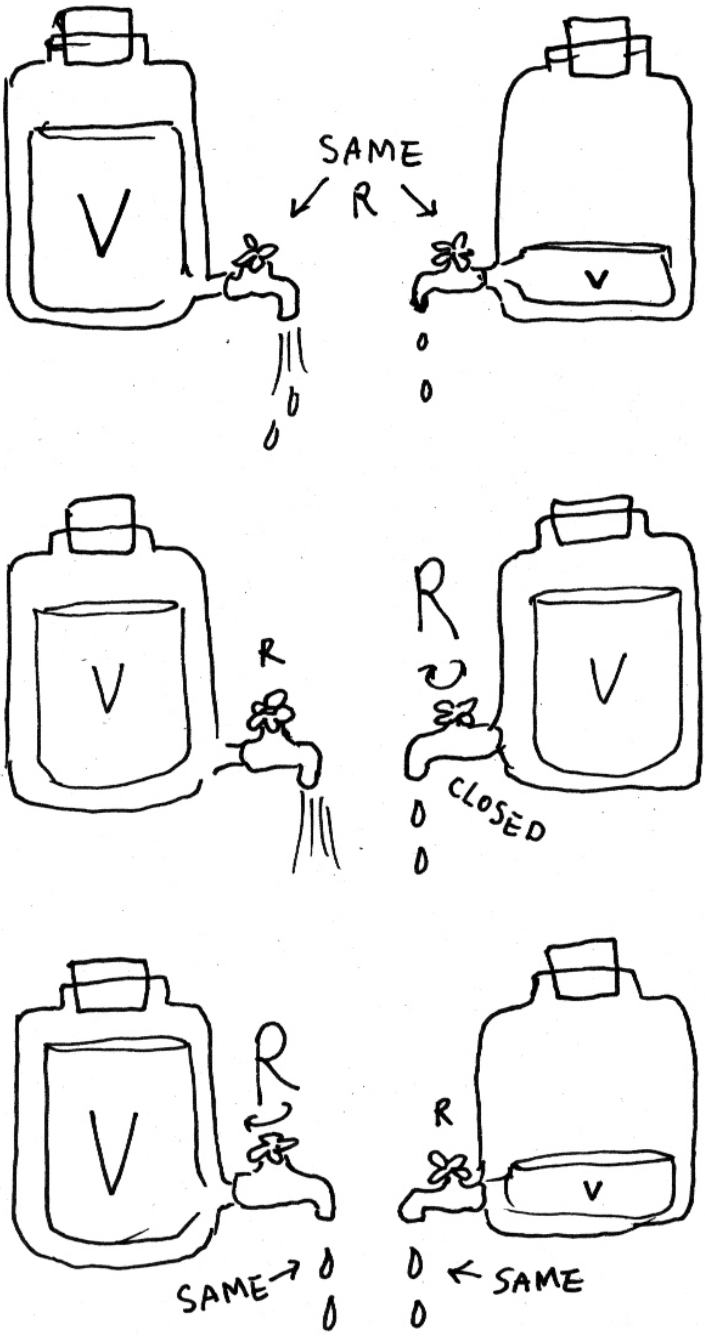


$V = I \times R$

$I = V / R$

$R = V / I$

Given any tow of the following: V(voltage), I (current/ Ampere), R (resistance, Ohm), you can find the other using the Ohm's law. It is often described with water analogy.


V
SAME
R
V
V
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V
R
CLOSED
V
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V
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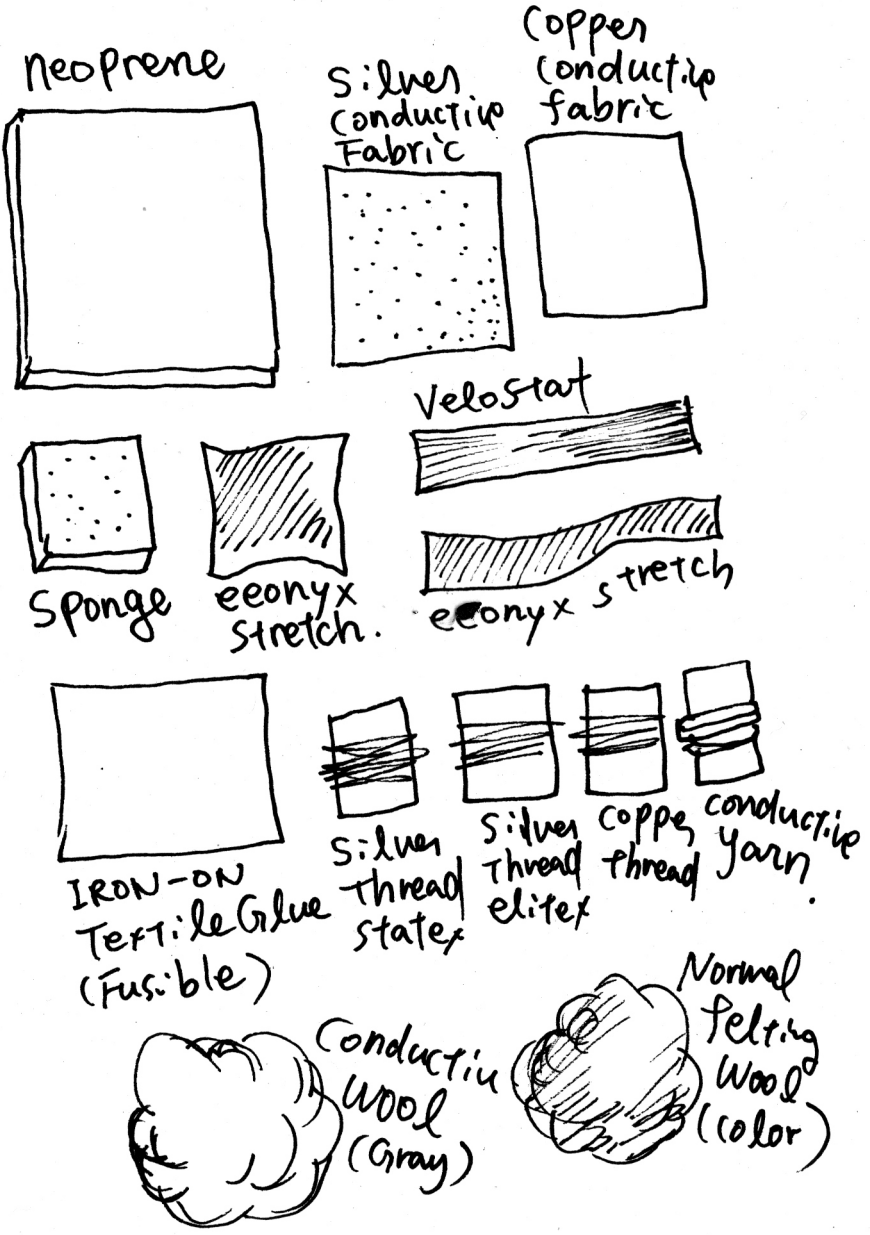
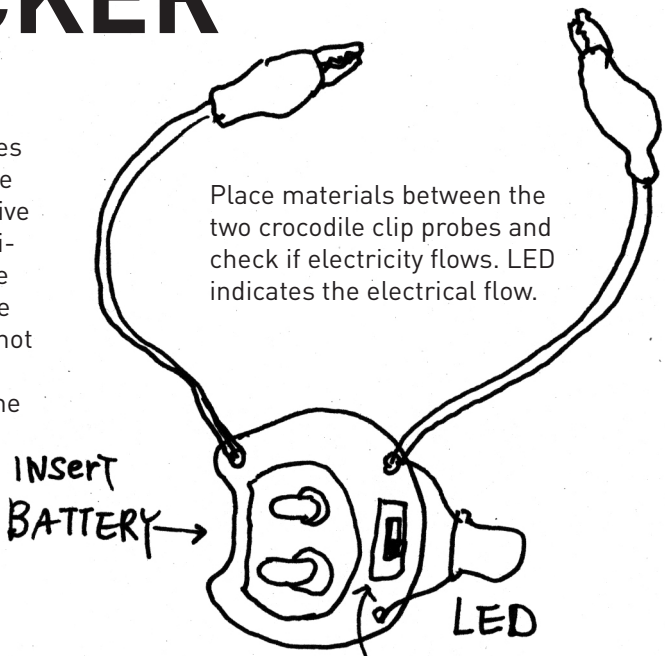
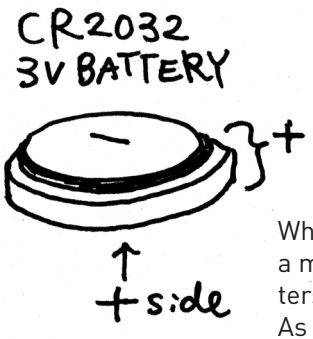
Materials included in your package:



DIY ELECTRICAL FLOW CHECKER

CR2032, or commonly called coin cell batteries provide 3V. Inside of the black ring is the negative (-) side, the rest is positive (+). When you leave it on a table, make sure the + and the - side is not touching a conductive fabric/thrad at the same time. It will drain the charge.





When working with electronics, it is a good idea to use a multimeter: a tool to measure electricity. Multimeters can measure resistance, current and voltage.
As we do not have enough multimeter for everyone, we use this DIY checker to get an idea about conductivety of the materials we
are working with.

Copper Conductive Fabric

Corrosion proof copper-silver plated polyamide ripstop fabric, Highly conductive.

Producer: Statex
0.03 ohm/sq ★

Silver Stretch Fabric

Silver plated knitted fabric, 78% Polyamide + 22% Elastomer plated with 99% pure silver. Highly conductive.

Producer: Statex
1 ohm/sq ★

SOFT&SAFE

70% bamboo fiber and 30% Silver. woven fabric

Vendor: lessEMF
1ohm/sq

SILVERELL

16% Silver/nylon + 84% Rayon, Knit jersey.

Vendor: lessEMF
5ohm/sq

SaniSilver

One-sided Pure Cotton, other is conductive silver. Double weave cotton and silver fabric
Vendor: lessEMF
Silver side: 1ohm/sq
Cotton side: 100ohm/sq

SAFETY SILK

65% silver, 35% silk; 43 g/m². Natural Silk plus Pure Silver.
Highly conductive on both sides
Vendor: lessEMF
1ohm/sq

RIPSTOP SILVER FABRIC

Silver plated nylon

Vendor: lessEMF
0.25ohm/sq

VeilShield

Polyester plated with Zinc/Nickel/Copper. 70% light transmission. 0.1 Ohm/sq resistivity

Vendor: lessEMF
0.1ohm/sq

Jersey from Maybachufer Markt

Material accidently found at the local textile market. It has some metal content, probably for aesthetic purposes, and it is highly conductive. It was 3 Euro/ m. It was a lucky find.

Vendor: Maybachufer Markt

Eeonyx Resistive non-woven

Resistive material, non woven coated with organic conductive pol mers. Application example: Pressure sensor, Bend sensor.

Producer: Eeonyx
20k ohm/sq

Eeonyx Resistive Stretch

Resistive material, knit/ jersey coated with organic conductive polymers. Stretch in both direction. Application example: Pressure sensor, Stretch sensor.
Producer: Eeonyx
20k ohm/sq

Velostat

Carbon impregnated black polyethylene film. Application example: Pressure sensor, Bend sensor.

Producer: 3M
500 Ohms/cm

Resistive Stripe Knit

Bekinox BK50/2 and elastane yarn are knit with industrial circular knitting machine. Each gray stripe is conductive with high resisntance. It changes its resistance when stretched.

Producer: Self-made at Swedish School of Textiles

Bekinox W 12/18 (loose fibre)

Wool 82% stainless steel fiber 18%. Resistive material. Suitable for wet and needle felting. Application example: Felted pressure sensor.

Producer: Bekaert

High Flex 3981 copper

Fine copper fiber / silver plated copper fiber, plied with synthetic fiber core. Solderable. Highly conductive.

Producer: Karl Grimm

★

Elitex

Silver Plated synthetic thread

Producer: Imbut GmbH

★

Shieldex

235/34 Polyamid thread plated with silver.

Producer: Statex

★

Conductive Yarn

Nm10/3 conductive yarn, 80% polyester 20% stainless steel, light grey
Unfortunately it is out of production.

Producer: plug and wear

★ Ⓡ

Bekinox Conductive Yarn BK50/2

Nm50/2 conductive yarn, 80% polyester 20% stainless steel, light grey.
Application example: knit pressure sensor, Stretch sensor

Producer: Bekaert

Ⓡ

25% Metal Egypto Color Gold Gimp

very heavy in weight but supresingly fluide in working

Vendor: Bart and Francis

15%metal Gimp fantasy

Metal ribbon wrapped arond black non-conductive fibre. Antique embroidery thread. Solderable. Pay attention when connecting as not all the thread surface is conductive.

Producer: Bart and Francis

Look around your house, near-by shops and see if you can find electrically conductive materials. Sample it and make a note.

note:

note:

note:

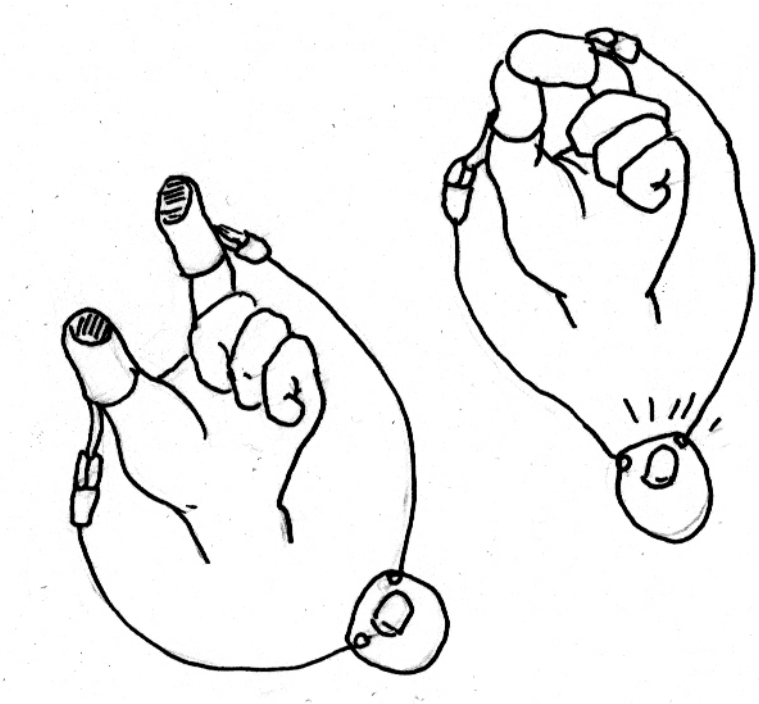
note:

note:

note:

Contact Switch

Any two conductive materials can act as contact switch. When the two meet, electricity can flow through the switch. Place conductive fabric or conductive thread on fabric surface, using iron-on textile glue (fusible) or stiching down the conductive fabric, or embroider with conductive thread. You can be creative in shapes, placement and techniques.

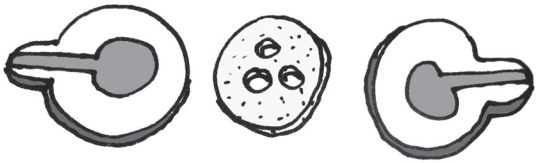


Connect your DIY electrical flow checker and see if you can switch on/off the LED light. Try different placement on fingers. Can you detect different hand gestures? You can also think of other types of interaction and think about where it contact/detatch when you do/undo the action.

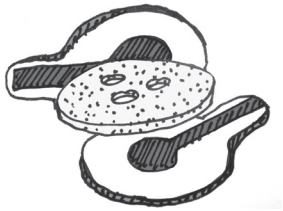
Fabric Pushbutton

Using conductive fabric as the contacts for soft push button and perforated foam as a spacer material, this fabric pushbutton is an extremely basic construction that can be used in many different ways.

Decide on your button shape and cut out two of these shapes from a non-condcutive fabric such as neoprene or felt. You can add tabs to your shape as contact points if fyou like.



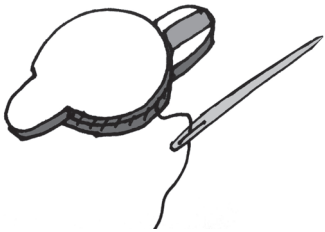
Cut out two pieces of conductive fabric with tabs that reach the edge of your button shape. Fuse these pieces of conductive fabric to your base material.

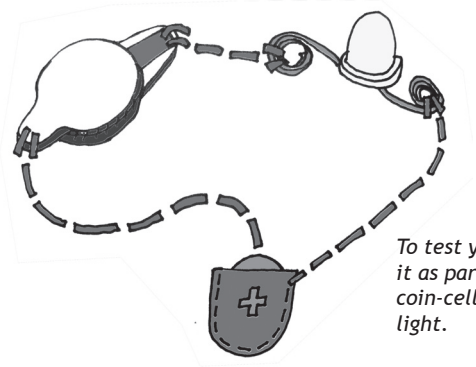


Cut a piece of foam to size so that it covers the conductive fabric but fits inside the button shape. in the center of the foam cut one or more holes.

Layer your materials so that the conductive fabric faces inwards with the perforated foam in between.You can arrange the tabs of your fabric button any which way you want so long as the don't overlap.

Thread a needle with regular sewing thread. Tie a knot in one end and proceed to sew around the edge of your sensor. Be sure to stitch both sides of neoprene together, you do not need to include the foam in your stitch, as it will stay in place.



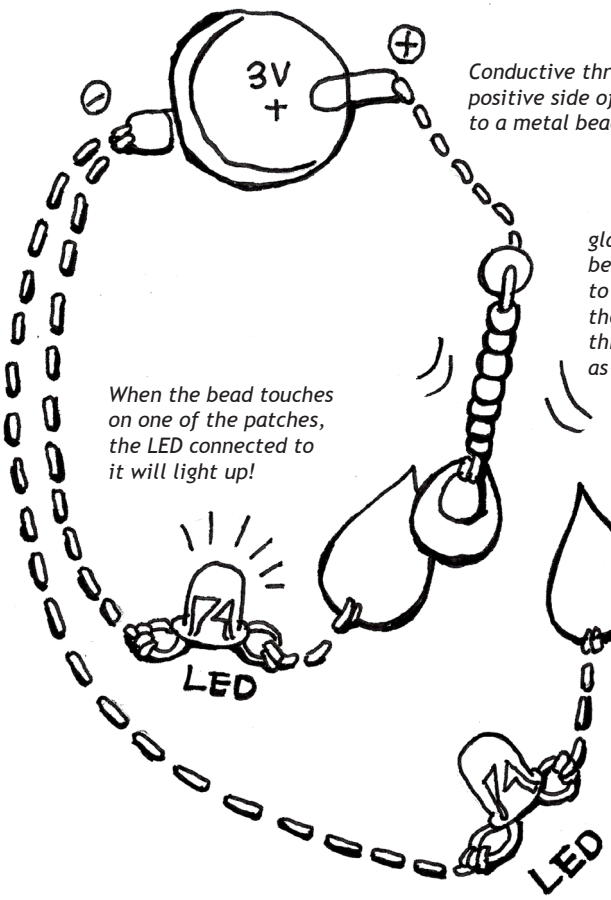


To test your pusbutton you can connect it as part of a simple circuit. Using a coin-cell battery pocket and an LED light.

Beaded Tilt Switch

A super simple tilt switch made from a metal bead strung on the end of condcutive thread, and a patch of conductive fabric nearby.

This sensor is made by stringing a metal bead to the end of a piece of conductive thread. A patch of conductive fabric is fused to the base fabric so that when the metal bead swings to a certain point it makes contact with the patch, closing the switch.



Conductive thread is sewn from the positive side of the battery pouch to a metal bead strung at the end.

glass or plastic beads are used to insulate the conductive thread as well as decorate it.

When the bead touches on one of the patches, the LED connected to it will light up!

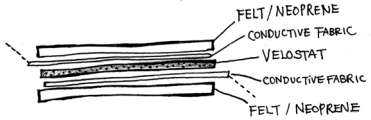
In this case two conductive fabric patches shaped like drops are fused to the base fabric on either side of where the metal bead can swing.

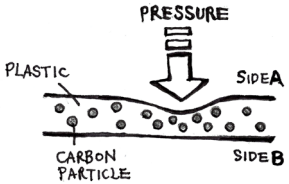
LED lights are sewn in between the conductive patches and the negative battery lead.

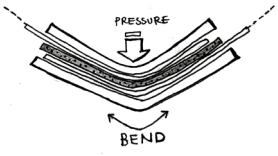
Neoprene Bend Sensor

This sensor is constructed by layering conductive and piezoresistive materials. Velostat is a piezoresistive plastic film that reacts to pressure with a decrease in electrical resistance. The sensitivity of this sensor can be adjusted by controling how large the conductive areas on either side of the Velostat are.

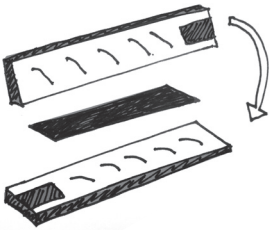
To make a bend sensor with a good range the conductive area should be minimized to just a few points of overlap. To achieve this the contacts on either side of the Velostat are stitched into neoprene as diagonal lines so that when they are sandwitched together they cross and only overlap in one point.

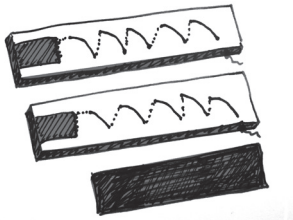




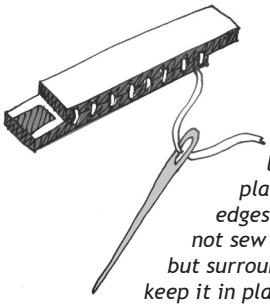


Cut two same size strips of neoprene. Thread the needle with conductive thread and tie a knot in one end. Stitch into the neoprene, exposing the thread in diagonal stitches as shown in the illustrations. Finish sewing the conductive thread by connecting it to a patch of conductive fabric at one end of the neoprene strip. This will make contacting the sensor easier.





Layer a piece of Velostat in between the two pieces of neoprene, with the conductive stitches facing each other. The conductive fabric tabs should be on opposite ends. Make sure the conductive thread and the conductive fabric on either side never touch directly, only through the Velostat.



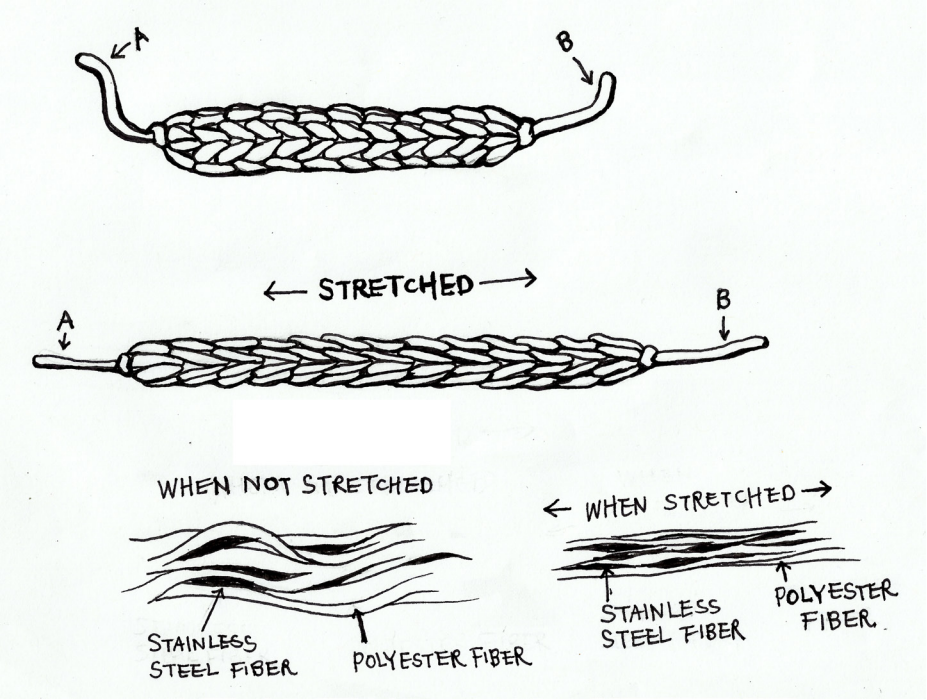
Thread the needle with regular sewing thread. Holding the layered materials in place, stitch around the edges of the neoprene. Do not sew through the Velostat, but surround it with stitches to keep it in place.

To test your finished sensor, connect either end to a multimeter set to measure resistance (Ohm). As you bend or pressure the layers of the sensor together, the resistance should decrease. Depending on the construction of your sensor, the values should range from 2K Ohm to 200 Ohm.

Knit Stretch Sensor

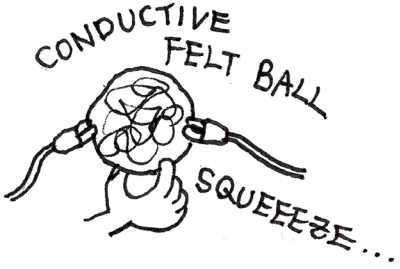
Stainless steel yarn is perfect for knitting or crochetting stretch sensors. The yarn is spun from a stainless stell and polyester yarn blend, making it conductive, but with a very high electrical resistance. When in a relaxed state the individual conductive fibers are not touching much, but when compressed through pressure or stretch, the steel fibers in the yarn make better contact and it becomes more conductive the more it is compressed. We can use this property of the yarn to sense stretch or pressure.

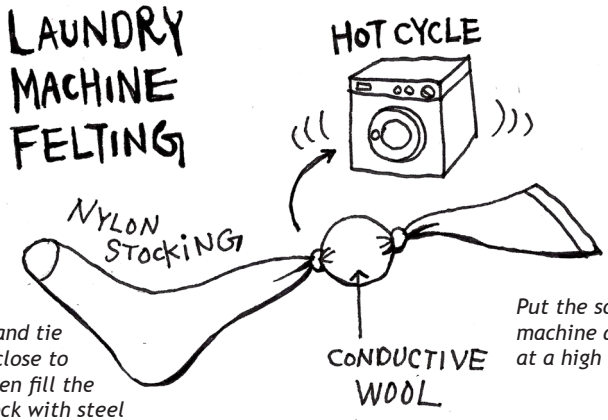
A single strand of yarn can already be used as a stretch or pressure sensor. But you can knit or crochet the yarn into any shape you like to make it more stretchy or squishy and giving you some feedback when manipulting the material.



Felted Pressure Sensor

When wool fibers are stimulated by friction and lubricated by moisture, they lock to each other and are “felted”. You can felt steel yarn into a conductive felt ball as it contains natural wool. This felt ball will act as pressure or squeeze sensor as it gets more conductive when the steel fibers are compressed.



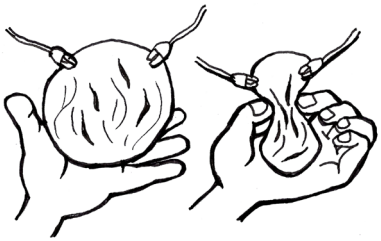


Take a sock and tie a knot in it close to the heel. Then fill the leg of the sock with steel wool fibers and tie another knot at the other end to form a ball shape as shown in the illustration.

Put the sock in the washing machine and wash with soap at a high temperature.

After washing, remove the felt from inside the sock and it shoudl have felted itself together into a nice ball.

To test your finished sensor, connect either end to a multimeter set to measure resistance (Ohm). As you squeeze or pressure the ball, the resistance should decrease.



CONDUCTIVE WOOL BALL