Polarizers

Materials

- 2 pieces of polarizing film
- Clear scotch tape
- Clear plastic square
- Light (Sun, lightbulb etc.)

A. Try this:

Cut pieces of tape and place onto clear sheet (be sure to add layers of tape in multiple directions
Place your design between two polarizing filters and hold light source such as a window during daylight or an overhead light.

1. What do you see when you hold it up to an overhead light? What happens when you hold it up to a window facing the sun?

What's going on?

The colors you see here result from differences in the speed of polarized light as it travels through the transparent tape. In transparent tape, long polymer molecules are stretched parallel to the length of the tape. Light polarized parallel to the stretch of the molecules travels through the tape more slowly than light polarized perpendicular to the stretch.

Every material has an index of refraction, which is the ratio of the speed of light in a vacuum to the speed of light in the material. Light travels through the tape you used in this demonstration at two different speeds. Materials with this property are called ***birefringent***

When polarized light enters the tape, its direction of polarization will probably not line up with the length of tape. If the light is polarized in a direction that does not line up, its direction of polarization will be resolved into two perpendicular components. One of these components will be parallel to the length of the tape, and one will be perpendicular.

The waves that compose these two components are initially in step with each other. But as they travel at different speeds through the tape, they go out of step (the crest of one wave no longer lines up with the crest of the other). When these out-of-step light waves emerge from the tape on the other side, they recombine, making light with a polarization different from that of the original light.
The thicker the tape is, the more out of step the components will become, and the greater the change in the polarization will be.

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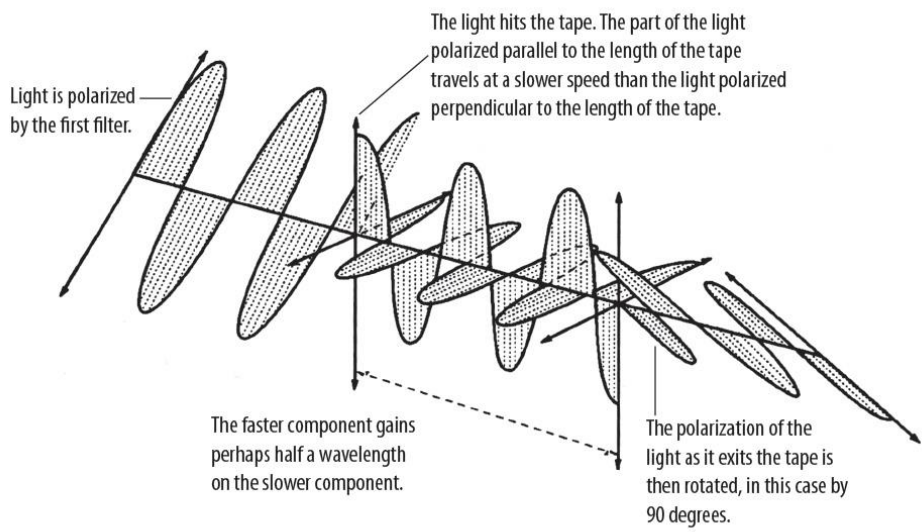
B. Try This:

Try rotating one of the polarizing films while holding your tape display and the other polarizing film still.

1. What do you see now? Has anything changed? Describe any changes below

What's going on?

White light is made up of light of all different colors, or wavelengths. Since the index of refraction of the tape is different for each color of light, each color has its own unique pair of speeds as it passes through the tape. The result is that the polarization of each color is changed by a different amount for a given thickness of tape.



When a second piece of polarizer is placed over the tape and rotated, it transmits different colors at different angles. This accounts for the color combinations you see at a given angle, and for the changes in color as the polarizer is rotated. Photo via www.exploratorium.edu