

# Soy Ink

## Objective:

Recognize that properties of biomass make them sustainable substitutes in industrial products; test the properties of soy oil and soy lecithin in making ink.

## Keywords:

- Ink
- Solvent
- Toner
- Soy oil
- Soy lecithin

## 21<sup>st</sup> Century Skills Represented:

- Environmental Literacy
- Creativity & Innovation
- Critical Thinking & Problem Solving
- Communication & Collaboration

## National Science Education Standards:

- Earth & Space Sciences: Earth & Human Activity
- Physical Science: Matter & its Interactions
- Engineering, Technology & Applications of Science: Engineering Design; Links Among Engineering, Technology, Science & Society

## feedstocks

Crop - oil from soybeans

## processes

Mechanical - blending

## uses

Dyes/pigments/ ink

## Background

What is ink? What is it made of? Ink is basically pigment mixed in a liquid that will not blur when you put it on paper.

Soybeans produce about 20% oil and 40% protein. After soybeans are harvested, they are cleaned, cracked and de-hulled. The oil is separated from the protein. Soybean oil is slightly refined and then blended with pigments, resins and waxes in order to make soy ink. Soy ink has many benefits over petroleum-based inks:

- Helpful in paper recycling because it can be removed more easily in the de-inking process,
- Degrades faster,
- Contains low levels of VOC's (volatile organic compounds), which helps to reduce air pollution,
- Less pigment is needed which means the ink is cheaper to produce, and
- Better performance producing brighter colors and shaper images.

Soy ink is not perfect. It cannot be used in ball point pens. It takes a longer time to dry than petroleum-based ink. But scientists will continue to work to solve these challenges because using a renewable resource (i.e. soybeans) rather than a non-renewable resource (i.e. petroleum) to make ink makes sense.

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## Materials

*Per group of 2-3 students:*

- 2 Post-It Notes - 3 x 3 inch size, yellow or light color
- Toothpicks
- 3 - 6 oz. clear plastic cups
- 2 pipettes to measure 1 mL of liquid
- 1/8 tsp. measuring spoon
- 1 mL of oil-based model paint
- 1 mL of liquid tempera paint
- 2-3 sheets of newspaper
- Access to water
- 3 paper towels (reserve 1 for experiment and 2 for clean-up)
- 1/8 tsp. soybean (i.e. vegetable) oil
- 1/8 tsp. granular lecithin
- 1 tsp. varying colors of unsweetened powdered drink (like Kool-Aid)
- 2 stir sticks
- 1 8.5 x 11 piece of paper for printing or blank cards
- 1 - 2 rubber stamps or paint brushes

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## ***Pre-Lab Preparation***

1. Discuss these questions:
  - a. What are the ingredients in ink?
  - b. How do the ingredients in ink work?
2. Divide the students into groups of 2 or 3.
3. Have each group get 2 cups.
4. Pour water into one cup until it is  $\frac{1}{2}$  full.
5. Use pipette to add 1 mL of liquid tempura paint to the cup of water. Stir with stick.
6. Record observations about the liquid and tempura paint in lab notebooks.
7. Pour water into the second cup until it is  $\frac{1}{2}$  full.
8. Predict: "What will happen when 1 mL of model paint is added to the water?" Record this prediction in the lab notebook.
9. Add 1 mL of model paint to the water in the second cup. Stir with stick.
10. Record observations about the liquid and model paint in the lab notebook.
11. Dip a Post-It Note into the liquid in the first cup. Dip another Post-It Note into the liquid in the second cup. Place both Post-Its on newspaper to dry.
12. Compare Post-Its and record observations in the lab notebook.
13. Answer the following questions:
  - a. Why do you think you got different results from different types of paint?
  - b. What is the difference between these two kinds of paint?

## ***Lab Procedures***

1. Divide the students into groups of 2-3.
2. Have each group get one plastic cup and add 1 teaspoon of water and 1 teaspoon of unsweetened powdered drink. Blend using a stir stick.
3. Add  $\frac{1}{8}$  teaspoon of soy oil to the mixture and stir.
4. Add  $\frac{1}{8}$  teaspoon of soy lecithin to the mixture and stir well until the lumps are gone.
5. Fold a paper towel in half and then fold in half again. Pour the "soy ink" into the center of this folded paper towel.
6. Test the soy ink; use a rubber stamp or paint brush to print images on paper.
7. Try different colors and adjust the recipe to do three additional tests. Record in the lab notebooks:
  - a. Describe the additional tests you created and the results.
  - b. What can we do to make the color brighter?
  - c. What can we do to make the ink dry faster?

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## ***Post-Lab Discussion/Question***

1. Instruct the students to answer these questions:
  - a. What happened when you added oil to the liquid?
  - b. How did lecithin change the mixture? Why did it have this effect?
  - c. Compare your inks in terms of consistency, color and result on paper.
  - d. What did you know about ink and printing before you did this activity? What did you learn?
  - e. How could you change the “recipes” for this soy ink? What differences would you predict these changes would produce?
  - f. List the benefits of using soy ink over petroleum-based ink.
  - g. What other biomass could be used to substitute for petroleum in industrial products? Describe the product and the biomass.
  - h. How can you use more renewable resources and agricultural products?
  - i. How can you reduce your dependence on non-renewable resources and products?
2. Have a class discussion about these questions and answers.

## ***Expansion Ideas***

- Create book covers, wrapping paper, and stationery with soy ink.
- Interview a local printer or tour a newspaper facility to get the answers to these questions:
  - What problems were scientists and engineers trying to solve when they tested soy ink?
  - Why do newspapers choose soy ink?
  - Do consumers know/care that their newspapers are printed with soy ink?
- Research and experiment with soy crayons. Compare the process of making soy crayons with soy ink. Test soy crayons and compare them to petroleum-based crayons. Design a survey to see which crayon your friends prefer.

## ***Evaluation of Learning***

- Students successfully create and test three different soy inks.
- Students turn in results, observations and answers.

## ***Resources***

- Videos
  - [Soy Ink](#) from YouTube by Alabama Soybean Producers
- Websites and Articles
  - [Soy based ink](#) from Green Wiki
  - [Soy What? Soy Ink Makes a Splash](#) by GreenBiz Staff
  - [How is Petroleum Used in Ink?](#) by Lexa Lee, eHow Contributor

# Soy Ink

## **Contacts**

- AGC Sustainable Print Solutions, Cleveland, OH: [http://www.visitagc.com/soy\\_vegetable\\_inks.php](http://www.visitagc.com/soy_vegetable_inks.php)
- Weisenbach Recycled Products, Columbus, OH: <http://www.weisenbach.com/index.html>
- Ohio Soybean Council, Columbus, OH: <http://www.soyohio.org>

*Project supported by a Secondary Education/2-Year Postsecondary Education/Agriculture in the K-12 Classroom grant from the United States Department of Agriculture - National Institute of Food and Agriculture under Award No. 2010-38414-21028. Any opinion, findings, conclusions or recommendation expressed in this publication are those of the author and do not necessarily reflect the views of the U.S. Department of Agriculture.*