



The Properties of Paper: Opacity, Water-Drop, and Ink-Mark Test

Grade Level: Science Grades 2, 4, 5, 8

Time: 45 min

Objectives: Students will be able to plan and carry out investigations to observe and record results by using the opacity, water-drop, and ink-mark test so they can learn about the different paper materiality and characteristics and describe results.

I Can Statements: I can: (1) test paper for opacity; (2) test paper for water and ink absorbency; (3) use accurate vocabulary; (4) use tools safely and responsibly

Georgia Standards of Excellence:

Science

2nd: S2P1.a

4th: S4P1.a

5th: S5P1.a.c

8th : S8P.c.d

Vocabulary:

absorbency — the ability to soak up liquid

opaque — not able to be seen through; not transparent, blocking the passage of light

objective tests — assess a specific part of the learner’s knowledge using questions which have a single correct answer

opacity — the quality or state of matter that makes it unaffected by light or radiant energy; the capacity of matter to obstruct the passage of radiant energy

subjective tests — scored according to personal judgment or to standards that are less systematic. They assess areas of students’ performance that are complex and qualitative. Though there are not necessarily right or wrong answers, responses are scored based on their appropriateness or quality. An example would be an essay question.

Materials: One set of each per group: 1 plastic dropper, 1 piece of blotter paper, 1 clock with second hand or stopwatch, 1 microscope, 1 hand lens, 1 ink pen (uni-ball vision works well), felt tipped pen or thin marker, 1 ruler, 1 roll of transparent tape, 1 plastic screw-top jar of water, 240 mL (8 oz), 1 piece each of notebook paper, newsprint, paper towel, copy paper, magazine paper, and toilet paper

Preparation: Prepare 1 - 4"x1" strip of the 6 paper samples for each student or group. Tape pieces can also be pre-prepared. Make "How well can you read me through the paper?" signs, 2" x 1", one per student or group. Blotter paper should be large enough for all paper samples to fit on without touching.

Essential Questions: (1) What is the meaning of a subjective test? (2) What kinds of tests can be designed to measure the opacity, and absorption? (3) What kinds of paper have a greater opacity? Why? (4) Why should different types of paper have different absorption rates?

Introduction: In this lesson, students will conduct tests for opacity, water absorbency, and ink absorbency. Students will work in pairs or groups for activity.

The degree to which a paper prevents someone from seeing through it is called its *opacity*. Printers call it the "show-through" of paper. Paper that is very *opaque* is hard to see through. The higher the opacity, the lower the show-through. Instructors will demonstrate placing one paper sample over the question ("How well can you read me?") and record results on data sheet. Then instructor will demonstrate the process for rating the paper sample.

The rate at which paper absorbs water can determine how the paper is used. Students will compare water-absorption rates and time how long it takes for a drop of water to be totally absorbed by different types of paper. Instructor will demonstrate by placing a drop of water on a paper sample and timing its absorption rate using the clock or stopwatch. Then instructor will demonstrate how to record results and rate paper samples.

How ink reacts with paper is important to printers, writers, and artists. Generally, we want to be able to write on paper with ink, but we want the paper to resist absorbing too much ink. Instructors will demonstrate how to hold pen at 45-degree angle, leaving pen tip on paper for 10 seconds. Instructors will analyze mark on paper sample with hand lens/microscope, noting how much ink spreads, and characteristics of the mark. Instructors will demonstrate how to record results and rate paper samples.

Procedures: Students will write down their predictions of which papers will have the greatest opacity, most absorbency, and smallest ink spread.

I. Opacity Test

1. To compare the opacity of the sample papers, students will complete the following steps. Place the first paper sample over the question below. Observe which words show through some papers more than others. If the words cannot be seen through the page, the paper has *high opacity*. If the words can easily be read, the paper has *low opacity*. Record observations and results.

*How well can you read me
through the paper?*

2. Repeat process for the other five paper samples.
3. On the basis of how well the print is read through each paper sample, rate the samples from “1” for low opacity (high show-through) to as much as “6” for high opacity (low show-through).

II. Water-Drop Test

1. Place each paper sample on the blotter paper. Fill the dropper with water.
2. As one student places a drop of water onto the first sample, another starts timing. Record how long it takes the water to be absorbed by the paper and soak through to the blotter paper.
3. If the water is not absorbed after 1 minute, students will repeat the process on the remaining samples. Other samples should be checked periodically.
4. If any water drops have not been absorbed or have not soaked through after 10 minutes, students can try comparing the degrees of wetness on the underside of those samples.
5. Based on how much water was absorbed, rate each sample from “1” for low absorption (not all water was absorbed) to “6” for high absorption (all water was absorbed quickly).

III. Ink-Mark Test

1. Hold the tip of the pen on the first paper sample at about a 45-degree angle. Hold pen there for 10 seconds. Record whether the ink made a small mark, or if the ink spread out on the paper.
2. Use ruler to measure the width of the mark. Record results- is it a uniform circle, or does it appear feathery? Use the hand lens and microscope to take a closer look at the ink mark.
3. Repeat process for the remaining paper samples.
4. Based on how small and uniform the ink mark is, rate the samples from “1” for the least uniform and largest mark to “6” for the most uniform and smallest mark.

Wrap Up

Once all groups have finished all tests, discuss results with class. Use the critical thinking questions to lead discussion. (1) What is the meaning of a subjective test? (2) What kinds of tests can be designed to measure the opacity, and absorption? (3) What kinds of paper have a greater opacity? Why? (4) Why should different types of paper have different absorption rates?



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Predictions:

Which paper will have the greatest opacity? _____

Which paper will be the most absorbent? _____

Which paper will have ink spread the least? _____

Results:

Paper Type	Opacity Test	Water Drop Test	Ink Mark Test
Notebook paper			
Newsprint			
Paper Towel			
Copy Paper			
Magazine			
Toilet Paper			