

# Writing and performing SOPs

*Why are SOPs important in biotechnology?*

*What components are needed for an SOP?*

In science, details matter. Being able to follow laboratory protocols is important in biotechnology careers, especially entry level positions within the laboratory. In this activity students will learn the importance of SOPs in biotechnology, identify the key components of an effective SOP, and observe how to create a basic SOP outline using an everyday routine. Lastly, students will create a more relevant SOP based on an important biotech skill used everyday.

## Ohio Standards

**Biology, Chemistry, Environmental Science, Human Anatomy and Physiology**

- Scientific Inquiry, Practice and Applications; Science is a Way of Knowing

## Student prior knowledge

Students need to have a basic understanding of how to follow step-by-step protocols.

## Suggested timeline

30–40 minutes

## Materials

Access to videos:

- CDC Fight Germs. Wash your hands. [youtu.be/eZw4Ga3jg3E](https://youtu.be/eZw4Ga3jg3E)
- Eppendorf. How to pipette in 5 easy steps. [youtu.be/Wx8cLzD-C04](https://youtu.be/Wx8cLzD-C04)

## Teacher preparation

1. Gain access to the videos above.
2. Review videos to give guidance where needed for students.
3. Prepare stations for each group of students who will watch and complete the procedure described on each video.

## Procedure

1. Have half of the group use GloGerm on their hands, then show the CDC video on hand washing. Check hands for glowing after washing hands. Have them complete the steps necessary to communicate the SOP.
2. Have half the group practice the pipetting technique. Check for accuracy using a balance. 1 mL of water equals 1 g, so the mass should equal less the mass of the tube. Have them complete the steps necessary to communicate the SOP.

## Suggested wrap-up

Make the connection that SOPs provide consistency to their products. Have students think of their favorite food. For example: Oreos! The great thing about Oreos is that each Oreo tastes the same within the package as well as across packages and time. A recipe is followed to ensure this consistency. That recipe is a SOP.

## Differentiation

These activities can be used as remediation for students who need extra review or individualized practice following SOPs.

## Extensions

1. Other activities could be used to demonstrate or evaluate students' ability to create SOPs. These could include:

- How to get ready for school
- How to pack a backpack
- How to make a sandwich

There might be differences across SOPs, leading to discussion about whether the order matters for the activity. Teachers could have students create SOPs for classroom activities they are most familiar with.

2. Depending on the age group, an inquiry lab could be given where students would iterate the creation of a SOP that illustrates their process in carrying out the investigation across more than one day.

### For example:

1. Question/problem
2. Variables
  - Independent variable: changed / tested (only one)
  - Dependent variable: What you measure (data)
  - Control (what you don't change—constants)
3. Research (answers the question, gives background on topic)
4. Hypothesis (Expected results; testable statement with measurable outcome)
  - Sometimes in an "if... then..." statement form
5. Testing the question to find data to support your prediction
6. Protocol
  - Add details, such as appropriate measurements
  - Have a materials section
  - Repeatable; someone else can follow it exactly
  - No assumptions
7. Collect data (evidence; measurable results!)
  - Examples of measurements (numerical)
    - Counting
    - Weigh / find mass
    - Volume (mL, L, etc)
    - Length
    - Temperature change
    - Pressure change
    - Color spectrophotometer
    - Time
  - Tables, charts, graphs (appropriately labeled)
8. Analyze; draw conclusions
9. Accept or reject your hypothesis
10. Witness signature
11. Lines in "empty" spaces

## Support information

- SOPs are many times proprietary, designed by the lab for their own use.
- Training on SOPs is provided to lab personnel by the quality control supervisor or a manager.
- Skills such as pipetting and following protocols are critical for smooth operations in lab and factory settings.

## Career connections

- **Quality control supervisor:** ensures that a company's products and services meet the client's requirements and perform according to agreed-upon standards. Duties include: training new employees, determining and distributing work assignments, monitoring employee performance, and performing regular audits of departments and production lines to ensure they comply with company standards.
- **Lab technician:** tests and analyzes body fluids, such as blood, urine, and tissue samples; operates laboratory equipment, such as microscopes and automated cell counters; and uses automated equipment to analyze multiple samples at the same time.