# Study, Track, remOve & Prevent: Using Hands On Litter Surveys to Teach the Scientific Method

Study, Track, remOve and Prevent (STOP) is a survey method to gather data on types and abundance of litter. STOP consists of measuring a 100 ft (or less) transect, picking up all trash larger than a cigarette butt in that area, then cataloging items. Participants enter surveys into online databases like the Texas Litter Database (txlitter.org) where it is used by scientists for research.

This lesson will walk students through the scientific method. They will make observations, form a hypothesis, conduct an experiment, analyze results, and discuss their findings. Science TEKS addressed in the lesson are listed in Table 1.

| Grade | Science TEKS |
|---|---|
| K | 1A, 1B, 1E, 1F, 3A-C |
| 1 | 1A, 1B, 1E, 1F, 3A-C |
| 2 | 1A, 1B, 1E, 1F, 3A-C |
| 3 | 1A, 1B, 1E, 1F, 3A-C |
| 4 | 1A, 1B, 1E, 1F, 3A-C |
| 5 | 1A, 1B, 1E, 1F, 3A-C |
| **6** | 1A, 1B, 1F, 3A-C |
| **7** | 1A, 1B, 2A-E |
| **8** | 1A, 1B, 2A-E, 3A, |
| **HS Biology** | 1A, 1B, 2A-D, 3A, 3C |
| **HS Environmental Sys** | 1A, 1B, 2A-D, 3A, 3C, 4C |
| **HS Aquatic Sys** | 1A, 1B, 2A, 2B, 2D, 2E, 3A, 3B, 8B |

*Table 1: TEKS covered in this lesson*

## Introduction:

Like it or not, litter is nearly everywhere! Many of the items we use each day produce trash and when that trash is not properly disposed of it creates litter.

A nonprofit group named Keep America Beautiful conducted a nationwide study on why Americans litter. *Littering Behavior in America,* research from Keep America Beautiful, reports on three nationwide studies—behavior observations, intercept interviews, and a national telephone survey. These explore how frequently people litter, the individual and contextual variables that contribute to littering, and the effectiveness of various approaches to reduce littering. The survey documents the composition of litter across America, its quantity, and locations, and the direct and indirect costs of litter to communities and businesses and compares them to a 1969 study.

Researchers literally watched people litter in public places and then went and asked them survey questions! The study found some really interesting clues about why we don't dispose of our trash properly.

*Why is litter a big deal? Besides being ugly, litter has environmental consequences:*

1. Wind and weather, traffic, and animals move litter into gutters, lawns and landscaped areas, alleyways, and parking structures.
2. Litter near storm drains and beach debris are also likely to wash into local waterways, with potential for serious environmental contamination.

3. Animals can be seriously hurt or killed by eating or becoming entangled in litter. Litter (especially plastic) can hurt us as humans by contaminating our drinking water and food on a microscopic level.

### Litter is primarily the result of individual behaviors.

- In the 2009 national survey, the first since 1969, 15% of individuals self-reported littering in the past month.
- In 1969, 50% admitted littering. While self-reported littering rates have declined in the past 40 years, individual littering—and litter—persists.
- About 85% of littering is the result of individual attitudes. Changing individual behavior is key to preventing litter.
- Nearly one in five, or 17%, of all disposals observed in public spaces were littering. The remainder (83%) was properly discarded in a trash or recycling receptacle.
- Most littering behavior—81%--occurred with notable intent. This included dropping (54%), flick/fling of the item (20%), and other littering with notable intent (7%).

### The community environment also influences littering behavior.

- A strong contributor to littering is the prevalence of existing litter. About 15% of littering is affected by the environment, or existing litter.
- Trash receptacles are widespread, while ash receptacles are less common. Of the sites observed, 91% had trash receptacles (including dumpsters), but only 47% had ash receptacles. And even fewer had recycling containers (12%).
- Most littering occurs at a considerable distance from a receptacle. At the time of improper disposal, the average estimated distance to the nearest receptacles was 29 feet. The observed littering rate when a receptacle was 10 feet or closer was 12%, and the likelihood of littering increased steadily for receptacles at a greater distance.
- Individuals under 30 are more likely to litter than those who are older. In fact, age, and not gender, is a significant predictor of littering behavior.

### Preventing litter requires changing individual behavior—and the environment

- **Make proper disposal convenient and accessible.** Provide sufficient trash, ash, and recycling receptacles. There is a special need for more ash receptacles.
- **Ensure consistent and ongoing clean-up efforts.** Littered environments attract more litter. Decrease the amount of existing litter.
- **Use landscaping, improving the built infrastructure, and ongoing maintenance to set a**
- **community standard and promote a sense of personal responsibility not to litter.** Communities that make an effort to “beautify” result in lower rates of littering behavior.
- **Make the most of awareness and motivational campaigns.** Use messaging that highlights social disapproval for littering and a preference for clean, litter-free communities. Messages that show littering as common undermine littering prevention. And keep the focus on individual responsibility.

## Get students thinking:

Ask students questions before you give them any background information to gauge their knowledge and get insight on specific observations they can make about their personal environment.

Questions to get the conversation going:

1. What do you call garbage when it's not in a can or bag?
2. Have you seen litter in your neighborhood? Near the school? In the school?
3. What do you think makes up most litter? Paper? Plastic? Glass?
4. How does litter make you feel? Does it make a place better or worse?
5. Can litter hurt animals? Why do you think that?

## Methods:

Your class will conduct a litter study in an area on campus or near the school. You could use a playground, park, sports field, etc. Make sure that the site is easily accessible by your class and safe for students to roam around (avoid roads and busy parking lots).

*Your class will then conduct the scientific method to determine what kind of study they want to pursue.*

*In the classroom*

**1. Ask questions.**

Every scientific study starts with a question that a scientist wants to answer. Start with broad questions then you can try to steer them towards more specific questions about the school yard or community.

Why do you think we litter?
Where is litter the worst in a place you've seen?
What could help the problem?

**2. Do background research.**

Have students read up on litter. Keep America Beautiful ( https://www.kab.org ) and the Texas Department of Transportation (http://www.dontmesswithtexas.org/ ) have excellent resources. The Texas Litter Database has charts and maps available for you to use in class as well! Demonstrate on the website in front of the class (txlitter.org).

Use the maps on the Texas Litter Database https://txlitter.org/data/maps to examine trash surveys in your area. Zoom in and out, click on points reported to see data on the kinds of trash people collected. Some areas don't have many surveys yet, remember that this is information reported by citizen scientists and volunteers. The program has been going the longest around Houston, so it's a good part of the state to explore the most observations.

Look at the charts on the Texas Litter Database https://txlitter.org/data/charts to explore the composition of trash collected in surveys. If you click on the categories at the top of the graphs, you can turn them off and on. At the bottom of the charts, you can use the slider to look at different date ranges.

All of the graphs and charts are available to export as an image for later! Click on the arrow on the top right to download.

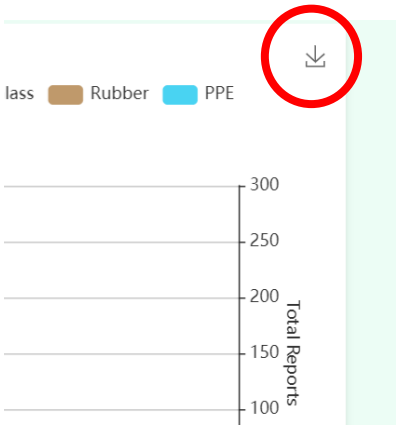


*Figure 1: Click on the arrow to download an image of the graph*

**3. Create a hypothesis.**

Keep it simple with students! Try and guide them into a hypothesis that is easily answered by yes/ no. Examples could be:

- "Littering will be greater in an area with no trash cans."
- "Putting up a sign saying not to litter will decrease the amount of trash on the ground."
- "If half of the playground is kept free of litter by our class cleanups, we will observe fewer students littering there than a control area where we did not clean."
- "There will be more trash near the parking lot than on the playground"

**Remember that a yes/no answer to the hypothesis is key.** You may need to write a sentence a student gives you on the board as a starting point and walk them through revising certain words. Try to work in words like greater, less, decrease, etc. The hypothesis is something that they will need to approve or disprove depending on the trash data they collect. Having those words that help compare the number of trash items makes this easier.

**For older students: Talk about your variables.**
In science we want to test different aspects in our experiments, called variables. We have independent and dependent variables in a test.

- Independent variable: what we are changing. Examples could be adding trash cans, conducting cleanups, doing a school campaign.
- Dependent variable: what you are watching to see what happens. You don't have control on the dependent variable, it's an unknown! Examples are number of students that litter, amount of litter on the ground, number of students that report having seen a sign, etc.

*Outside in your study area*
**4. Test your hypothesis.**
It's time to do some trashy tests!

*Materials Needed:*
We recommend the following materials ready to go into the field:

1. Trash bags
2. Gloves - sturdy gloves that will protect your hands from dirty and sharp objects
3. Close-toed shoes - to protect feet from any sharp objects on the ground
4. Water - hydration is important!
5. Tool to measure length of transect a piece of rope/ string or a tape measure
6. STOP instruction form and data logging sheet (see below for details)
7. Fish scale for getting weight of trash (optional)

*Trash Collection Protocol*
The method we use to collect and record data is called the STOP (Study, Track, remOve, and Prevent) Method. A recording sheet can be found at this link (https://txlitter.org/TX_Litter_DB_Field_Sheet.pdf). Detailed instructions on the STOP method are covered below.

- **Define start and end points of your transect.** Choose easily identifiable start and end points. Landmarks around the school or park are great and easily visible for students. You can also use cones or tape to mark off an area you'll be surveying. If your students are high achievers, you can go back and replicate the survey at a future date. Replicating data is great and allows scientists to see trends over time.

**What's a transect?**
A transect is a line across a habitat or part of a space. It helps give a measurable area to test.

- **Mark the edges of the study area.** How wide an area will your students survey? 20 to 30 feet out each side of the transect is normally a good width. So if your transect is 100 ft long and you expand your area out 20 ft on each side, you'll end up with a 4,000 sq ft area. The transect can be adjusted to any size you need. Do a shorter length and or width with younger students or in very dirty areas. Put cones or tape to indicate the boundaries of the study area. Now it's time to practice the STOP (Study, Track, RemOve, Prevent) method!
- **Start the survey!** Record start time online or on your printed data sheet. Pick up every piece of trash within the transect. Have students be very thorough. We advise picking up anything the size of a bottle cap or larger. Record stop time.
- **Weigh bagged trash in pounds, record.** We recommend using a hanging fish scale. Students will likely need help with this. While weight isn't a requirement, it is a nice metric to collect to expose them to different ways to think about data collection.
- **Sorting and tallying your finds.** Assign a designated recorder to tally debris (or do it yourself with younger students. This person will either use a phone or a clipboard and printed log to record the types and numbers of trash found. Remaining group members are sorters. Sorters will sort and count trash, calling out items to recorder e.g. "four plastic straws." The easiest way to do this is to dump the trash and sort it into piles of like materials before counting and calling out the results. For small items found in large volumes, e.g. plastic film fragments or styrofoam fragments, estimates of the total number can be provided. Once all trash has been sorted and logged, it can be rebagged and dropped in a nearby dumpster or trash can.

*Figure 2: Sorting trash collected before tallying on the datasheet*

**5. Examine your results.**

With younger students, write some of your big findings on the board and ask them to make comparisons. Remember that they can compare actual items (plastic bottles, straws, snack wrappers) or the larger categories (hard plastic vs paper items).

With older students, you can use the provided Excel table to enter your numbers and look at graphs.

This is a great time to bring in a math component- use averages, means and percentages to display data.

**6. Support or reject your hypothesis.**

Have students discuss the data and draw conclusions.

- Does the data support or disprove your original hypothesis?
- What could you do in a future study to follow up and learn more?
- What was unexpected that could have altered your results?

If you'd like (and have time), you can then design a new hypothesis and test!

## Follow Up and Resources:

Make your school aware of your project results! Send a newsletter to parents, display posters in the hall, and engage your PTA or school board to discuss what students found. Bring in art aspects by having students make posters about their findings or putting on a play.

**Share your data and help Texas scientists!**

You and your students can enter the results of your litter survey in the Texas Litter Database (www.txlitter.org). Scientists are using this data to map areas of heavy litter in hopes that we can discover ways to prevent it. Full instructions on entering your data can be found on the website here: https://txlitter.org/guide

We're here to help! Keep Texas Beautiful has partners all over the state if you have questions or need help. Visit https://ktb.org/contact-us/ for more information.

*References:*

The 2009 National Visible Litter Survey and Litter Cost Study, America Beautiful,
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