

AP[®] Chemistry

ACCESS TO CLEAN WATER

Student Workbook



AP[®] with WE Service



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Getting to Know the Topic

Access to Clean Water: Globally

Clean water isn't a luxury, it's a basic human right, and it's the fastest way to change a life. However, more than 840 million people around the world live without access to safe water and sanitation. In 2015, the UN acknowledged the human right to clean water with Sustainable Development Goal 6—aimed at ensuring the availability and sustainable management of water and sanitation for all—calling upon all countries to support this goal.

Without access to clean water, girls and women waste hours a day fetching water from unsafe, distant sources instead of going to school or earning a livelihood. Families lack access to healthy food sources because their farms fail from droughts. And communities are trapped in the cycle of chronic illness from drinking and using contaminated water. When we tackle the water crisis, we're also tackling the barriers to education, health care, nutritious food, and opportunity.

Fast facts

- ▶ Every year, students miss 443 million school days because of water-related illnesses.
- ▶ Women and girls around the world spend over 200 million hours every day collecting water.
- ▶ 40% of the world's population are affected by water scarcity.

Taking Action Globally

How can students take action at school and in their community to improve global access to clean water?

Here are some ideas to get them started:

- ▶ Host a fundraiser and raise money to help build improved water systems and provide clean water education and water projects.
- ▶ Carry out an awareness-raising campaign to educate others about the water crisis.
- ▶ Contact government leaders to push efforts for improving access to clean water in developing communities.

Another option is to support and fundraise for the WE Villages program. Students can support this program by visiting [WE.org/we-schools/program/campaigns](https://www.weschools.org/we-schools/program/campaigns) to get ideas and resources for taking action on global water issues.



**More than 840 million people
around the world cannot access
safe drinking water.**

Getting to Know the Topic

Access to Clean Water: Locally

Water scarcity and water sustainability issues are indeed a global concern, but they also affect us locally. In the U.S., water sources are slowly disappearing.

There are many factors that contribute to the growing scarcity of our water sources, such as climate change and growing populations. Low rainfall also means that aboveground lakes are falling to low levels and even drying up. Almost half of the country's water basins that supply water to communities are being affected, including the ones that cover the central and southern Great Plains, the Southwest, central Rocky Mountain states and parts of California, the South, and the Midwest.

One example is Lake Mead in Nevada, which supplies 90 percent of Las Vegas's drinking water. It is expected to dry up by 2021. Once depleted, these water sources cannot be replenished.

Fast facts

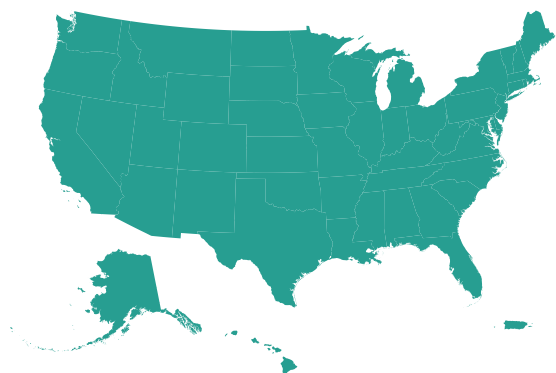
- ▶ Irrigation for farming uses more than 75% of water in the U.S.
- ▶ By 2071, 96 out of the 204 water basins supplying most of the U.S. with fresh water could fail to meet monthly demand.
- ▶ According to the U.S. Environmental Protection Agency, as much as 50% of the water we use outside is wasted due to inefficient watering methods.

Taking Action Locally

Within their local or national community, students can:

- ▶ Work with local governments and organizations to learn the reasons for rising water costs and how to make clean water accessible to all.
- ▶ Raise funds that support organizations in improving access to clean water.
- ▶ Raise awareness through workshops or campaigns to educate others on reducing wasteful water usage.

With both their global and local actions, encourage students to be creative with the ideas they develop through their action plans.



**21 million Americans
are getting water from
systems that violate
health standards.**



NAME: _____

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Personal Water Use Chart

In the U.S., most of us have access to some of the safest treated water in the world. This is not the case in other parts of the world, where clean water is not as easy as turning on the tap. Water is an important part of our daily lives and we use it for a wide variety of purposes, but do we really understand how much we use?

In this activity, you will track your water use for one week. We will then calculate the average water use in the class and the community in general.

ACTIVITY	M	T	W	TH	F	S	S	TOTAL # OF TIMES	ESTIMATED WATER USED (GALLONS)	TOTAL WEEKLY WATER USE (GALLONS)
Washing face/hands									1	
Taking a shower									50	
Taking a bath									40	
Flushing a toilet									5	
Brushing teeth									2	
Drinking water									0.25	
Cooking a meal									3	
Washing dishes by hand									10	
Washing dishes using dishwasher									15	
Washing a load of laundry									30	
Washing car									50	
Watering lawn									300	
TOTAL										

Average Weekly Water Use of the Class _____

Average Daily Water Use of the Class _____

Average Daily Water Use of the Town _____

In some parts of the world, water is not readily available and you would have to walk miles to a well to retrieve water to use in your home. Would you be willing to walk to a well and carry all the water you would need for a day back to your home?



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Clean Water Crisis

As you complete your research, complete the charts below. You will be able to fill in the rest of the chart as groups share the information they have gathered. Be sure to cite your sources.

What are the major pollutants that effect the clean water source?

GROUND WATER	SURFACE WATER	POLAR REGION

What effects do these pollutants have on human health?

GROUND WATER	SURFACE WATER	POLAR REGION

What are the sources of these pollutants? (Industry, agriculture, natural minerals, etc.)

GROUND WATER	SURFACE WATER	POLAR REGION

What factors limit the access to clean water in this region?

GROUND WATER	SURFACE WATER	POLAR REGION



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Problem Tree

In your Problem Tree graphic organizer, start by writing the problem in the trunk of the tree, and then look at the causes and effects of an issue. Keep digging to go deeper on the issue to find its supporting and root causes.

Leaves/branches: Effects

These are the results created by the problem. At first, this part of the issue appears easy to tackle, but when leaves and branches are trimmed, they grow back quickly. Consider the multi-layered effects, or “effects of effects,” that can arise when a problem goes unaddressed. Always ask: “Then what happens?”

Ex. Public health issues

Trunk: Problem

This is the key issue that is being studied. Because it is not as apparent as the leaves, the core problem itself sometimes takes a little longer to identify.

Ex. Contaminated drinking water

Roots: Causes

These are the situations or factors that have led to the problem. When exploring the root causes of a problem, ask yourself “Why does this problem exist?” Dig deeper to consider the “causes of causes”—the multiple layers of factors that contribute to a problem.

Ex. Lack of resources and government oversight



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Distillation of Ocean Water

A majority of water on the Earth is undrinkable for humans since it is found in the oceans. Humans cannot drink salt water, but saline water can be made into fresh water. The process is called “desalination.” Desalination uses a separation technique known as distillation. Distillation is as simple as boiling a salt water mixture, collecting the steam, and cooling it to return it to its liquid state.

This procedure sounds simple enough, but is it really? And is it a good procedure to create a reliable and cost-effective clean water source?

In this activity, you will set up a simple distillation apparatus to purify a sample of sea water and to collect data to determine if this procedure is an effective means of purifying water.

Before beginning the procedure, determine with your lab group what data you want to collect to determine the effectiveness of the cleaning procedure of the water. Keep in mind that you are trying to determine if this is effective on a large scale to provide clean water to parts of the world that do not have a source. Get your teacher’s approval of your data collection plan before beginning the procedure.

MATERIALS: 250mL Erlenmeyer flask, rubber stopper fitted with rubber tubing, 600mL beaker, test tube or other collection container for the “clean” water, ring stand (tripod), wire gauze, Bunsen burner or hot plate, boiling stones, sample of sea water

Procedure:

- ▶ Create a data table to record data in a clear manner.
- ▶ Obtain a sample of sea water and pour it into a 250mL Erlenmeyer flask and add several boiling chips. Stopper the flask with a 1-holed stopper fixed with a glass tube. Attach a rubber hose to the glass tube.
- ▶ Place the flask on the wire gauze that is supported on a ring stand. Place a Bunsen burner under the gauze. If using a hot plate, place the flask directly on the heating surface.
- ▶ Place the test tube or other collection container in the 600mL beaker that is filled with an ice water bath.
- ▶ Place the end of the rubber tubing into the collection container.
- ▶ Light the Bunsen burner or turn on the hot plate, and GENTLY heat the flask with the sea water inside. Make sure you watch so that the flask does not overflow and to be sure that pressure does not build up in the collection container.
- ▶ Continue to heat the flask until the desired amount of water has been collected.
- ▶ When finished heating, turn off the burner and allow all materials to cool before taking any measurements.
- ▶ Gather data and calculate results. Share results with the class.

Conclusion Questions:

- ▶ What methods of desalination are used throughout the world today?
- ▶ Is this process an effective means of purifying sea water? Support your answer with data.



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Treatment of Dirty Water

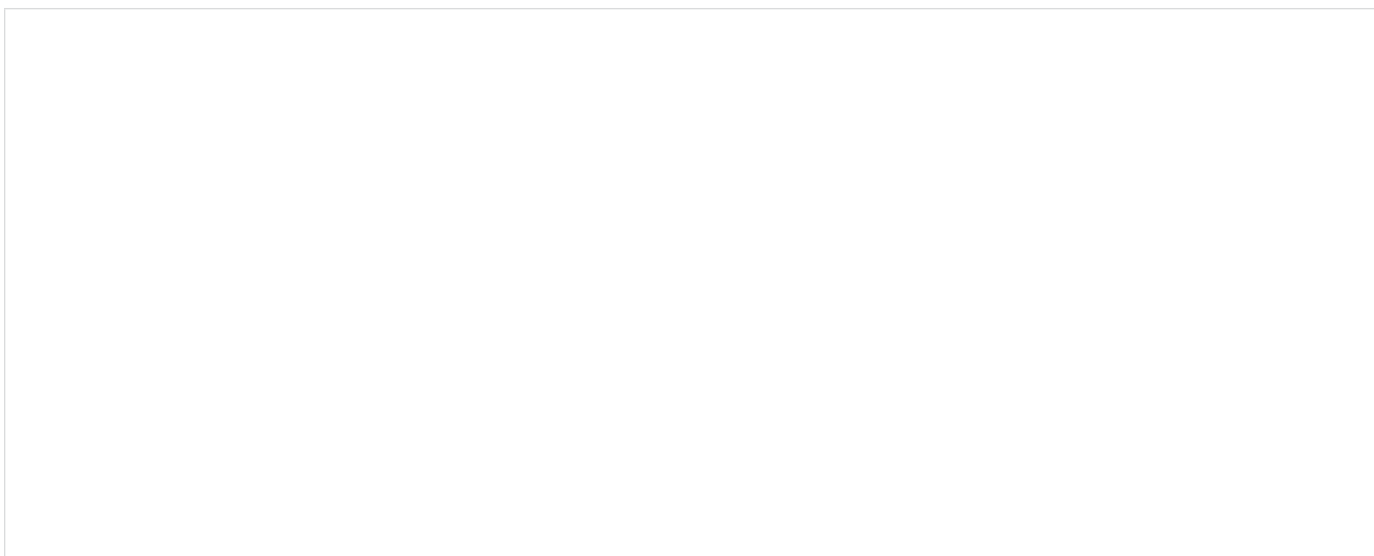
Describe the polluted water as thoroughly as possible.

Draw your filter system in the space provided.

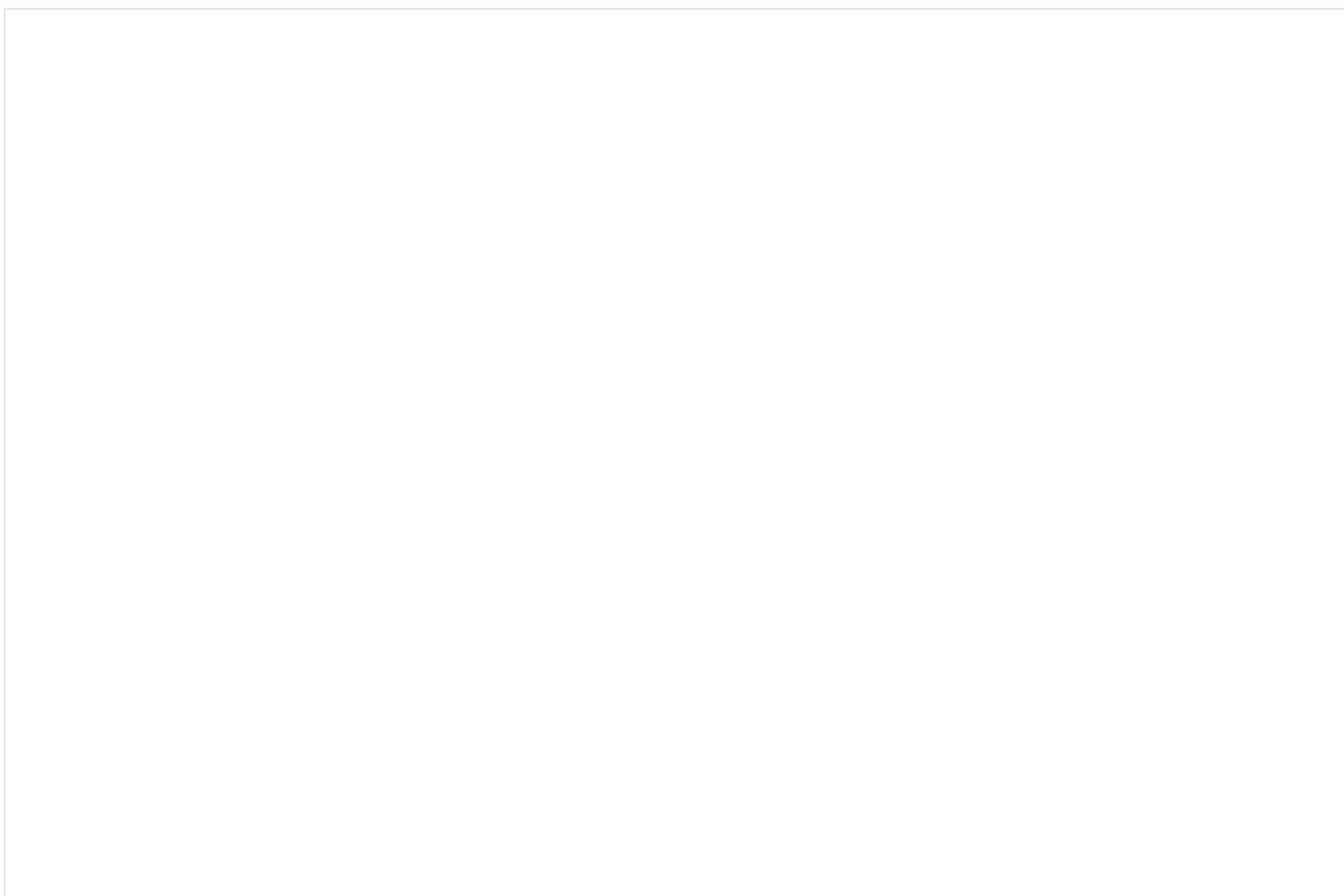
List the materials used in the filter and their use.

MATERIALS	USE IN FILTRATION PROCESS

In the space below describe the filtered water as thoroughly as possible.



How would you modify your filter for better results? Draw the new filter below.





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Needs Assessment

The following series of questions helps you to analyze and identify ongoing areas of need within organizations addressing your issue.

1. Identify 3-5 organizations working on issues related to the issue your team is working on.

2. What does each organization do well in response to the issue and/or related issues?

3. What could each organization do better in its response?

4. What areas of need related to access to your issue have you learned about that each organization is NOT addressing?

5. Considering all 3-5 organizations, where are there ongoing needs that are not being adequately addressed?

6. Considering all 3-5 organizations, where are there ongoing needs that are being addressed successfully, and to which you can add further efforts to support the issue?



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Solution Tree

In your Solution Tree graphic organizer, start by rewriting the problem from your Problem Tree, and reframing it as a goal at the trunk of the tree. Then consider the different solutions (the roots) and possible outcomes of the solutions (the branches).

Leaves/branches: Outcomes

These are the results created by the solution. Results may appear as straightforward as having achieved goals, but when you consider the ripple effects and outcomes of sustainable results, the impact is far-reaching and long-lasting. Always ask: "Then what happens?"

Trunk: Problem

Trunk: Goal

Roots: Solutions

These are the actions needed to solve the problem and achieve the goal stated at the center of the Solution Tree. When exploring solutions, ask yourself "How will this solve the problem?" Dig deeper to think holistically, so that you are looking beyond the short-term and addressing not only the symptoms of the problem but the root causes as well.

Solution Tree Worksheet: Copyright © 2018 WE. All rights reserved.



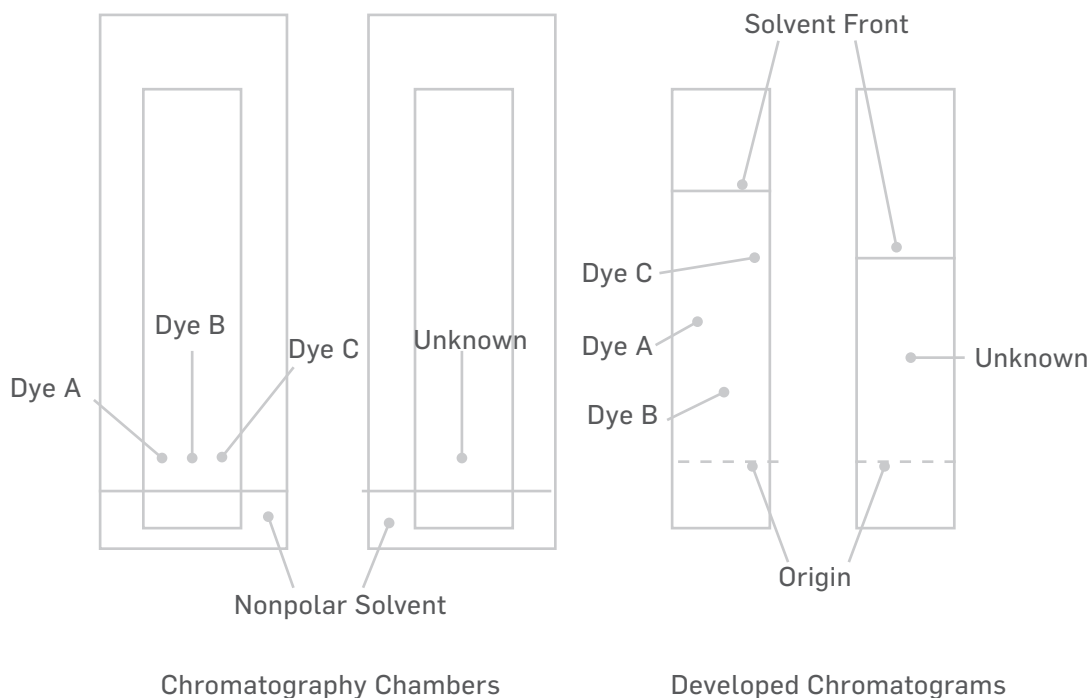
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Working Independently

A student investigates various dyes using paper chromatography. The student has samples of three pure dyes labeled A, B, and C, and an unknown sample that contains one of the three dyes. The student prepares the chromatography chamber shown below on the left by putting a drop of each dye in the identical position on the chromatography paper (polar material) and standing the paper in a non-polar solvent. The developed chromatograms are shown above on the right.

- Which dye (A, B, or C) is the least polar? Justify your answer in terms of interactions between the dyes and the solvent or the dyes and the paper.
- Which dye is present in the unknown sample? Justify your answer.





Approaches to Taking Action Information Sheet

DIRECT SERVICE

WHAT IS IT?	Personally engaging with and providing hands-on service to those in need (usually in conjunction with an organization).	
EXAMPLE GOAL	By the end of the semester, we will support a local food bank and shelter by packing and serving food to people in the community. We will also visit our neighboring elementary school and teach a lesson on food insecurity in our community.	
ACTIONS	<ul style="list-style-type: none"> Reach out to local shelters and food banks to arrange a day for the class to visit and provide hands-on support Once a date has been decided, make sure students all have permission to travel to the food bank (if during school hours) 	<ul style="list-style-type: none"> Connect with teachers/administration at local elementary school and arrange to visit a classroom to teach a lesson to young students on food insecurity Create and print worksheets to use with younger students

INDIRECT SERVICE

WHAT IS IT?	Channeling resources to the needs of a community—locally, nationally, or internationally.	
EXAMPLE GOAL	By the end of the year, we will create a storage and donation system for local families in need, where they can access furniture and other household items. We will develop a system for donations, pick-ups, and inventory.	
ACTIONS	<ul style="list-style-type: none"> Conduct research into which items are most needed by community members (e.g., bed frames, dining tables, household goods, etc.) Reach out to local businesses to try to get a storage space donated Connect with school social workers/administration to gain their support Put up flyers around school and in the community, asking for donations (list specific items needed), including instructions on how/where to donate 	<ul style="list-style-type: none"> Develop an online database for tracking donations and pick-ups, and maintaining inventory Share pick-up information with local shelters, churches, community centers, etc. Share the donation system with school social workers, so that they can maintain the project in future years

ADVOCACY

WHAT IS IT?	Educating others about an issue to increase visibility and following up with an action that focuses on enacting change. Actions around advocacy often look like raising awareness, but without a strong call to action within the initiative as a whole. Educating others is not considered service in and of itself.	
EXAMPLE GOAL	Through an informative art piece, we will educate our school community about the waste created by single-use plastic water bottles, and the impact they have on the environment. Then, we will sell reusable water bottles at school, and the proceeds from the sale will go toward clean water projects in developing countries.	
ACTIONS	<ul style="list-style-type: none"> Research the impact of single-use plastic water bottles around the school and in the local community Plan out and create a 3D sculpture that incorporates informative text on the issue of single-use plastics Seek permission from school administration to display the piece in a common area of the school 	<ul style="list-style-type: none"> Design and order water bottles to sell at school Research and select an international organization that focuses on clean water projects Organize a selling schedule for the water bottles, donate profits



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TEAM MEMBERS: _____

Creating the Action Plan

This outline serves as a basic template for your action plan. Use additional space and resources to help you build out each part with the right amount of detail and flow to ensure you have the strongest action plan that you and your team can implement with ease. Remember, this is your road map for your service project!

TEAM GOAL:

MEASURES OF SUCCESS:

Required Network and Resources

In order to complete this goal, our team will need to develop the following network and access the following resources:

NETWORK:

RESOURCES:

ROLES AND RESPONSIBILITIES

Each team member will take on the following roles and associated responsibilities:

TIMELINE

Our team will use the following timeline to complete tasks and successfully carry out the action to meet our goal(s):



NAME: _____

TEAM MEMBERS: _____

Five Action Planning Pitfalls Tip Sheet

Once your team has completed the major components of your action plan (creating your teams and setting goals, timeline, and network), review the five action planning pitfalls provided below to ensure these have been avoided. Review your plans—individually first, then together as a team. After the review, rework your action plans, if necessary.

1. Setting an unclear goal

The first and most important part of any action plan is defining the goal, or what you want to achieve. It should be clear and easy to understand, for example, “We want to collect 500 cans of food,” or “We want 200 people to learn about WE Villages.” If the goal is not clearly defined, proper planning will be difficult if not impossible. As a best practice, have a peer from another team review your goal to ensure it is as clear as you hope.

2. Planning unrealistic actions

After the goal is set, begin planning the actions necessary to achieve it. It is important that the steps make sense and are achievable. Do not plan unrealistic actions such as working at times that will interfere with schoolwork, overestimating how many people can help out, or planning to go to places that would be difficult for you to reach. Consider each team member’s school and community schedule, such as work and extracurricular activities. Before planning an action, ask yourself, “Is this action realistic?”

3. Rushing the process

Do not be too hasty in planning actions. While you may be excited to start, proper planning takes time. The better the planning and organization, the more success you will achieve. Even if it means slowing down to figure out details, do not rush and leave out important steps.

4. Not asking for help

Do not be afraid to ask for help. When a network is created, bigger goals can be achieved faster. Reach out to friends, parents and mentors. People generally enjoy helping, especially if it is for a worthy cause.

5. Not learning from mistakes and giving up too quickly

We all make mistakes—it is normal and healthy. Mistakes allow us an opportunity to learn and grow. So, learn from the mistakes. Ask, “Why did this happen?” and “How can I avoid this problem next time?” Actively think about the mistakes and how it will be better the second time around. If something does not go as planned, do not stop!

Notes

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