twig SCIENCE

Guide to Classroom and Language Routines







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Classroom Routines

Why Do We Have Classroom Routines?

Imagine it takes three minutes to move students from their workstations to a discussion area in the classroom. If you make that transition six times in a day, students will spend 18 minutes simply moving around the classroom. Research shows that tasks such as handing out paper, washing hands, and bringing the class to order have the potential to use up significant amounts of time that could be better spent learning.

This is where standard routines come in. Routines help students become efficient at carrying out basic tasks and procedures, and save valuable lesson time. Once the routine is automatic, you can concentrate on the learning and rather than wasting time on classroom management. What's more, all students like structure, especially those that live chaotic lives, and all students and teachers like to get good at something—including a classroom routine.

Below are six standard routines you can use in your classroom, which you can revise if necessary. Once you get good at them, you can start breaking your own rules and get creative.

Stop and Listen Routine

The Stop and Listen routine can be used to gain students' attention and help them refocus during lessons. The routine uses a signal to let students know they should stop what they are doing and listen.

Try the following:

Signal	Method
Clap Once, Clap Twice	Ask students to clap once if they can hear you, and wait for students to clap. Ask students to clap twice if they can hear you, and wait for students to clap twice. Students will know that when you clap, they should be silent.
Count Backwards from Four	Count down from four to zero. Students will know that by the time you say "zero," they should be silent.
Hand in the Air	Put your hand in the air, and wait for students to stop talking and put their hands up. Keep your hand in the air until all students' hands are up and the room is quiet.

1-2-3 All Eyes on Me	Say the simple phrase “1-2-3 all eyes on me!” and wait for students to respond with “1-2 All eyes on you.” Make plenty of eye contact with students around the room to ensure they are listening.
Music	Whistle a popular theme tune to get the class’s attention. For example, you could whistle the first two bars of the theme from The Addams Family—students should clap twice and be ready to listen. If you are not able to whistle loudly enough, you could use an instrument or a drum to get students’ attention.

Some things to keep in mind:

- Do not talk until all students are quiet.
- Do not expect immediate silence—it takes time for students to process the instruction you have just given.
- Do not repeat the signal—students may learn to ignore you the first time if they think there will be a second “final warning” signal.
- Once you have decided how you will use the different Stop and Listen routines, do not change them. Keep the actions and words in each routine consistent.
- You can use different routines throughout the year.
- Every now and then, choose a student to lead the routine for you.

Move Around the Room Routine

The Move Around the Room routine can be used when students move between different workspaces in the classroom. The NGSS and other 3-D science standards require students to engage in hands-on activities, discussions, and design and engineering challenges. This means that there will be more movement in your science lessons, and this needs to be managed.

This routine can be used when students are:

- Preparing for a Turn and Talk
- Picking up equipment and materials for an activity
- Moving back to their workstations after circle time (for a read-aloud or Spark discussion)
- Leaving the classroom to go into the schoolyard for fieldwork
- Moving to and from IT equipment
- Preparing to do a practical investigation that requires space
- Restless and need a short break.

It is helpful to model this routine with students, and practice repeatedly. Different strategies will work for different classrooms, so you may wish to experiment with variations. You may even wish to introduce a theme for the routine.

Try the following:

Method	Routine
Use Music	Play 20 seconds of music. All students have to move to the new position by the time the music stops, and be sitting up straight, looking at you, and ready for the next task.
Beat the Clock	Time the class's movements to see if they can beat their previous time. This method is very effective, but you must ensure that students move around the classroom safely and do not run.
Spot the Destination	Have students identify the area of the classroom they need to get to, and plan their route before they move. Remind students to be polite and respectful of other students as they do so. You could consider having students play paper, scissors, stone, with the winner moving first.
Phased Exit	Try moving one student table at a time. Elementary students may perceive a level of unfairness in who goes first, even if they are going to the same place, so you may wish to introduce a table movement rota.
Tuck In	When coming into the classroom after being outside or particularly athletic role-play, it can be helpful to have a general smoothing of clothing, and flattening of hair. It can help calm students before class starts.
Spread the Load	If several pieces of equipment are required for a practical activity, spread them round the room and ask each student team to be responsible for specific items. If any cleaning needs to be done before the items are returned, make sure that everyone knows who is responsible for this, and when they can return their items.

Wash Your Hands Routine

This routine aims to manage lesson time more effectively when students need to wash their hands after learning outdoors, handling plants and animals, or working with chemicals. Alcohol gel and wipes are known to be less effective, so soap and water are preferable.

Model the proper handwashing technique for students:

1. Rinse your hands so that they are wet.
2. Collect some soap in your hands.
3. Rub your hands together, including the backs and wrists and between the fingers while counting slowly to 20 (or singing “Happy Birthday”).
4. Rinse your hands until the soap is gone.
5. Dry your hands with a clean towel.

Focus on handwashing before meals and snacks as a priority, and practice the routine regularly. There are a wealth of online resources that will teach students why they need to wash their hands, which you might consider introducing at the beginning of each year.

Clean-Up Routine

This routine aims to encourage students to keep their classroom tidy by clearing away materials.

You could have students sing the “Clean-Up Song” (to the tune of “Camptown Races”) while they tidy their workstations.

Clean-Up Song:
Clean-up time, let’s sing our song
Doo-dah, doo-dah
Do your share, it won’t take long
All the doo-dah day.

Try the following to help students during clean-up:

- Have a clearly labeled station for waste materials.
- Give individual students specific responsibilities.
- At the start of the year, plan for extra clean-up time, so you can model for students.
- Have a clean-up checklist displayed in the classroom that students can follow.
- Think about using the music from the Move Around the Room routine. Set students the challenge of being sat down and ready for the next activity before the music stops.

Work with a Team Routine

This routine can be used when students work in teams of 4. Consider assigning each team member a role that has specific responsibilities:

- **Team Leader**—Makes sure everyone stays on task.
- **Coordinator**—Reinforces the Science Expectations, and substitutes when someone is absent.
- **Reporter**—Organizes the presentation.
- **Materials Manager**—Makes sure everyone has the materials, asks the teacher questions if needed, and leads the clean-up.

This type of routine can help students develop transferable skills. If students are successful, these skills can help them become more employable in the future.

There are five key aspects to ensure successful outcomes:

1. Allocate roles when students are working on a tangible outcome, and to a fixed deadline not too far in the future.
2. Give students time to become familiar with each role before any final assessment, so they know exactly what each person needs to do in the team.
3. Identify which aspect individuals are personally responsible for, and which will be the group's responsibility.
4. Allow students time to practice giving and receiving feedback, in order to learn how to communicate respectfully and successfully with others.
5. Be aware that some students may struggle with certain roles, and be sensitive to their needs. For example, a student who lacks confidence may struggle with the role of Team Leader if they are assigned the role too early or receive little support. Practice aspects of team building, and work up to the full experience later in the year if necessary.

Encourage positive discussions between students, and remind them it is important that:

- All students have a chance to talk.
- Only one person talks at a time.
- Peers ask clarifying questions to understand.

After paired discussions, ask questions to find out how successful students were, such as the following:

- Did you both take part in the discussion?
- Was one person talking at a time?
- Did you ask questions to clarify?

Science Tools Poster Routine

This routine allows students to track their use and application of Science and Engineering Practices (SEPs) as the grade progresses.

Students using Twig Science engage in the SEPs to investigate module phenomena through discourse, informational texts, and experiential learning. Students will not realize they are applying SEPs unless it is explicitly highlighted to them, and the Science Tools poster is a way of making this clear to them.

Throughout the program, you are supported to add to the Science Tools poster at point of use. Use the following guidance for making the poster, adding to it, and referring to it during lessons:

1. Prepare a poster on chart or poster paper with the title “Science Tools.”
2. Determine a place for the poster in the classroom where everyone can see it.
3. Explain to students that you will add to the Science Tools poster throughout the year, as they find other tools that scientists use.
4. When your students use an SEP in your lesson, add it to the poster and discuss it with the class. Ensure you leave enough room to list the remaining SEPs for the grade.
5. Explain what the practice is, and why it is important to scientists. You can use the **Guide to SEPs and CCCs** to help you.

Language Routines

Background to Twig Science Language Routines

The aim of the Twig Science language routines is to support questioning strategies as a tool for formative assessment, and promote argumentation. The first two language routines lay the foundations for effective classroom discussion. The other language routines (numbered 3–6) were originally developed by Stanford University's Understanding Language – Stanford Center for Assessment, Learning and Equity (UL-SCALE) team to support teachers with language demands of reading, writing, speaking, listening, conversing, and representing in math. These language routines are based on five key ideas:

- Teachers, peers, and texts serve as language resources for learning (Vygotsky, 1978).
- Deep learning of subject content and skills is gained through language, as it is the primary medium of school instruction (Halliday, 1993).
- Through successive and supportive experiences with math ideas, learners make sense of math with their existing language toolkit (Moschkovich, 2012).
- Language is an inseparable part of all human action, so when students are engaged in meaningful activities (projects, presentations, investigations), language develops through perception, interaction, planning, research, and discussion (van Lier & Walqui, 2012).
- Language routines help focus attention on student language that support in-the-moment teacher, peer, and self assessment (Cazden, 2001).

Why Use Twig Science Language Routines?

Within the NGSS/3-D science, science and engineering understanding and language competence develop interdependently. The language demands are rigorous, and the pragmatic applications in the classroom require attention to both subject content and language. In Twig Science, both subject content and language are addressed simultaneously because:

- The common thread of language connects all three dimensions of the NGSS/3-D science, as students are asked to communicate, evaluate, argue, explain, define, describe, predict, analyze, and question.
- Evidence from cognitive psychology suggests learning occurs when students are encouraged to think hard about the specific topic in question. Structured, complex conversations in the classroom place a higher cognitive demand on students—making learning more likely.
- Discussion is an effective, but currently underutilized, form of formative assessment, and has the potential to reduce the marking burden when delivering the NGSS/3-D science.

- This approach is particularly effective when teaching English Learners. The everyday language used by students can drive the process of learning, as they are able to articulate science ideas verbally without the need for “perfection.” Informal language can act as a bridge to deeper understanding.
- Scientific terminology needs to be used and practiced, and talking about new vocabulary regularly is an effective way of understanding their meaning.

Basic Ground Rules When Using Language Routines

1. There are three attributes of good quality conversation that are practical and fairly easy to spot in the classroom. Note, these are not appropriate for every language routine.

    - Make sure students take turns effectively.
    - Encourage students to build on previous turns.
    - Focus student conversation on the knowledge and skills related to the lesson objectives.

2. Most critically, if students have a conversation about phenomena, data from an investigation, or two separate sources of information, follow with a debrief to check their understanding. If you don’t do this, there is a risk that students will leave your classroom with incorrect ideas suggested by their peers. Check student understanding using whole class discussions, drawing/writing, or targeted multiple-choice questions.
3. High tech high schools have a rule when students are talking: hard on content, soft on people. KIPP says, “Work hard, be nice.” Make sure your class culture means students are prepared to think out loud without ridicule.
4. If you are pairing students, do it strategically. Many people suggest no more than a grade level in ability between pairs is ideal. Students that are one step ahead of their partner can be motivating, but 10 steps ahead can be disheartening.

The following describes the language routines that are embedded within Twig Science. There are many variations on the routines described, so feel free to experiment—there is no right way of doing them.

1. Whole Class Questioning Routine

It is important to think about how you ask questions in whole class discussions, as this sets the tone for any language routine used later. You should aim to involve as many students as possible, value every contribution, and help to support and develop a classroom climate where learning can be most effective.

- **a)** Have the whole class put their pencils down and look at you before asking questions.
- **b)** Consider using individual mini whiteboards. This ensures that all students stay engaged and provide an answer, rather than only the keen and able students who are often disproportionately favored in the traditional "hands up" approach.
- **c)** Leave a wait time of at least 30 seconds between asking the question and expecting an answer.
- **d)** Ensure there is an equal chance of any student in the classroom having to answer your question. For example, use approaches such as a popsicle stick lottery (drawing students names from a hat).
- **e)** Before the lesson, plan the five key questions you want to ask. Think about how they link to the lesson objectives, and the answers you might get from the students.
- **f)** Use the questions in the Twig Science Teacher Edition—you don't have to make them up. You can jot down extras you think of for next year.
- **g)** Vary the level of complexity of your questions using Webb's Depth of Knowledge Framework or the revised Bloom's taxonomy.
- **h)** Think about what you want to do with student replies, for example:
    - **i)** Have a Think, Pair Share
    - **ii)** Pause, Pose, Pounce, and Bounce for a second opinion
    - **iii)** Invite students to reply individually, and then supply a model answer
    - **iv)** Take a Socratic questioning approach (spontaneously asking a linked series of questions to try to get to the bottom of something)
    - **v)** Have a bank of stock follow-up questions

2. Turn and Talk

This routine will change as students get older, but the basic steps stay the same. It might go like this:

- **a)** Find a question or prompt for students to discuss. This can be specific in the early grades, e.g., "Can you think of one reason why the marble moved?" In later grades, you might give students a focus for discussion, such as a picture or a statement, e.g., "Talk about what is happening here."

b) Pair students strategically (as mentioned in the basic ground rules).
c) Arrange students in such a way that conversation is more likely—at K–2, this might be cross-legged on the floor, eye to eye and knee to knee; at 3–5, you might move the chairs around.
d) Model best practice with a student volunteer before you start. Make your expectations clear about eye contact, listening to (not shouting at) each other, and body language.
e) Manage the taking of turns by making it clear who goes first and when (e.g., assign students as "a" or "b," or make a rule that students near the door speak first). You can be more flexible with students in grades 3–5.
f) Have a list of model questions ready to suggest if students are struggling.

Students will need to be trained in the art of having a discussion, especially how to respond effectively to the first point that is made. Here are some ideas to focus students' minds on the different ways of doing this. You might want to model them several times before students try it on their own:

Teacher Request	First Response	Second Response (to extend the contribution)
Argue the evidence	I think that adult animals always look like their babies.	What evidence of that did you see in the interactive?
Make a prediction	What do you think happens to the UV beads if you add more sunscreen?	Would sunscreens with different sun protection factors make a difference to the results?
Paraphrase	I think the experiment we did and the reader we looked at tell us that a harder push makes the car go faster.	What scientific word did we use to explain the pushes and pulls?
Clarify	Is the question we have to answer about how to make the solar cooker hotter or work faster?	Does the other team agree with us?
I wonder...	I wonder what would happen to the ecosystem if all humans left Yosemite National Park for 100 years?	Let's focus on one plant or animal we have looked at, and estimate the population size over 100 years. Would anything die out completely?
Propose a solution to an engineering problem	I think bigger blades will make the wind turbine make more electricity.	Let's think about how we can test it. We could come up with two ideas between us?

Things to note…

- In earlier grades, restrict the Turn and Talk to a maximum of 1 minute or 1 comment and 1 response, and increase this as students become more proficient. If you feel student discussions are not productive, have students stop and refocus their attention.
- End the lesson with feedback, in any way you feel is appropriate (as mentioned in the basic ground rules). You might want to take a photo of the class and quickly annotate with students that produced a particularly effective answer, as a record of the interaction.

3. Stronger and Clearer Each Time

This routine is an extension of the Turn and Talk routine, and is designed to provide a structured opportunity for students to revise and refine both their ideas and verbal and written output, by having repeated paired conversations. For K–2 students, expect to work with them on the routine for quite a while before it's mastered.

The main steps to stronger and clearer each time are as follows:

a. Pre-Write/Draw: Students work individually to look at a problem or prompt, and draw/write their idea for solving the problem, and write down any thoughts or questions they have about it (in complete sentences if possible). There will be a post-write to see if sharing with others makes a difference to their understanding. **Optional:** Provide part of an initial draft for students to begin with, which contains the language needed for an important idea.
b. Think Time: Give students a minute to think about what they will say to their first partner to explain what they are doing (or did) to solve it. **Note:** Students can't look at what they wrote while talking.
c. Structured Pairing: Use a successive pairing structure. For example: Arrange students into groups of 6 or 8, and have inner circles of 3 or 4 students facing outer circles of 3 or 4 students. Remind students that speaking clearly and explaining reasoning are important. Even if students have the correct answer or both students agree, the goal of successive pairings is 1. for the listening student to truly understand the speaker's ideas, or 2. for students to clearly explain their ideas to others as a scientist would. Goal 1. is more appropriate when students are first introduced to a concept. Goal 2. is appropriate when students are further along in the development of a concept.
d. In Pairs: The listening partner can ask clarifying questions, especially those related to justifying, e.g, Why did you do that? They then share their ideas, and their partner asks clarifying questions to draw out more language and ideas.
e. Switch: Partners switch one, two, or three more times, strengthening and clarifying their ideas each time they talk to a new partner. Think about modeling the types of contributions that students could make during the stronger and clearer routine early on, as they are unlikely to know what to say otherwise. You can direct and structure the stronger and clearer routine more closely and be explicit about the ideas you want students to think about in each turn, until they become experts. Scaffolds can be

removed with each successive pairing to build student independence. **Optional:** When students switch partners, they can emphasize strength (focus on a science concept, science practice or crosscutting concept) or clarity (how to describe the science to others).

f. Post-Write: Have students return to their seats and write down (in sentences or drawings explained by sentences) their final explanations. Students can then see the impact that talking about a problem or an idea can have on their ability to explain it.

4. Collect and Display

The purpose of the Collect and Display routine is to capture the everyday language students use, so they can use this as a reference in developing their scientific language. This routine also helps students see their progress over time.

a. Listen for and note the language students use during partner, team, and whole class discussions. The critical aspect is to record the everyday words students use to describe specific scientific concepts and objects explored during a lesson. This is helpful, as you are starting where students are in their learning and tapping into their prior knowledge.
b. Just as you would learn a new language by starting with the words you recognize, this routine starts with language that is familiar to students. This means students can slowly build on their scientific vocabulary, rather than encountering too much academic vocabulary too soon.
c. Words are recorded on a word wall where every student can see them. What words do they use to describe force, an air mass or ice?
d. The words that are collected on the word wall can be organized, revisited, and explicitly connected to formal scientific terms. This gives all students the opportunity to refer to, build on, or make connections with them during future discussions or writing.
e. Throughout a module, you can reference the displayed language as a model, and update and revise the display as students' language changes. You can make bridges between student language and new scientific terms, e.g., pushes and pulls become forces; plant food becomes the need for air, water, and sunlight.

Circulate and listen to student pairs or teams as they work, and make notes (with helpful sketches or diagrams) about common or important words and phrases they use. Scribe students' words, phrases, and sketches onto a visual display, so you can refer back to them during whole class discussions. Ask students to explain how the words are useful, clarify their meaning, and reflect on which words and visuals help to communicate ideas more precisely.

An example based on waves:

Collect:
During demonstrations, make a note of the everyday language students use to describe wave phenomena. Capture the everyday language students are using that is especially relevant. This may include words such as waves, ripples, force, movement, motion, impact, center, source, starting point, travel. This output of language is important, as it will be used as a reference students can build on and connect to as they develop scientific language.

Collect:
As students explore the waves with their ropes, listen for and collect the everyday language they use to describe amplitude and wavelength. Don't expect students to use the terms amplitude or wavelength at this point. You will transition to the formal academic vocabulary later during the Display portion of the language routine.

Display:
Connect the everyday language you collected (e. g., students may have described wave characteristics as "going up and down," or talked about "height of the wave," "distance between the waves," "a bunch of waves," "number of waves"). Create a bridge from the informal language used by students to formal academic vocabulary, by restating (or recasting) their ideas and connecting them to the terms amplitude (the height of the wave) and wavelength (the distance between waves). Add the words amplitude and wavelength to the academic word wall.

5. Meta-Think-Aloud

The Meta-Think-Aloud routine is a metacognitive strategy, which teaches students to think about how they learn. This routine is particularly useful when supporting students with the Science and Engineering Practices.

Imagine students need to analyze a data set for the first time. You might show them the whole process you go through to process the data, produce a chart or graph, and then make sure what has been produced can be used as evidence to answer a scientific question. Verbalizing the task out loud before students start means they can follow your thinking process and try to emulate it themselves. They also have at least one strategy to try when they have to do this task again. When students feel comfortable, invite individuals to use the strategy in front of you to verbalize the problem you have given them, and the steps they are going through to solve it. Unless students are very confident, you should do this one-on-one or in small groups.

6. Critique, Correct, and Clarify

This routine should be used towards the end of a module, as a formative assessment or challenge for confident students who demonstrated secure knowledge. The routine lends itself very well to NGSS/3-D science Engineering Design Performance Expectations: students can be presented with a weak solution to an engineering problem, which they can then improve on, come up with several new designs or processes, and test each one. This routine should only be used when students' content knowledge is secure—a shallow knowledge of scientific content means students are unlikely to spot the problem, and could be further confused.

a. Present a partial/broken argument, explanation, or solution method. You can play the role of the student who produced the response, and ask the class for help in fixing it. Note: The given response could be a mocked-up media source, such as a blog, social media page, or a conclusion from an investigation. It should include an ambiguous term or phrase, or an informal way of expressing a scientific concept or a poor engineering solution, e.g., a term uncovered through the Collect and Display routine.
b. Invite students to identify the error(s) or ambiguity, and analyze the response in light of their own understanding of the problem. They should work both individually and in pairs to propose an improved response.
c. Ask student pairs to share their draft improved response.
d. Invite students to refine their own draft response.

Citations/Research to Support the Integration of Science and Literacy Strategies:

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