Scientific Connections *through* Inquiry

Edition 1

LEVEL 1

Sound & Movement

Sound Can Cause Movement

As your student absorbs this concept of vibrations traveling by the successive bumping of one particle into another, pose the question: Can sound make things move? Have your student watch sci.bz/fork1 and observe how striking one tuning fork causes another tuning fork placed nearby to start vibrating as well. The sound from the first causes the second to move. This is demonstrated by the fact that when the struck fork is damped, the tone continues to come from the second fork. Note that for this to work, the forks must be of the same note (frequency).

ACTIVITY NOTE

If you have two tuning forks tuned to the same frequency, try this yourself! It will work better if the tuning forks are close and both placed on the same hard surface. (Remember, sound travels better through hard solids than through air.)

SCIENCE NOTE

The reason this only works with tuning forks of the same frequency is the same reason the tuning fork makes a pure tone in the first place: the tines of the fork naturally vibrate at a certain frequency, called a "natural frequency." When the vibrations travel through the air from an identical fork, they strike the fork at exactly the right times to make it move. For a fork with a different natural frequency, the bumping of the air would sometimes make it move more and sometimes make it move less. This is similar to how pushing a child on a swing in the right rhythm makes them swing higher, but pushing at the wrong times can actually slow them down.

Watch sci.bz/sound1 to see another example of sound causing movement. When the pitch of the string is played, it makes the string vibrate.

To "see sound" from a loudspeaker moving another object, stretch plastic wrap tightly across the top of a large bowl, and use a rubber band to hold it in place. Set the bowl in front of a speaker and place several small balls of tissue paper on top of the plastic wrap. Play music through the speaker. What happens? Turn up the volume on the speaker and watch the balls jump and move. Why does this happen? (Think Time) The speaker produces sound, or vibration. This vibration travels through the air and causes the plastic wrap to vibrate. When the plastic wrap vibrates, the tissue paper balls bounce. If desired, try different types of music and see how the vibration varies.

SCIENCE NOTE

"Think Time" is simply a reminder to you, the instructor, to pause and give your student time to think about the question. When instructing, we tend to feel as if short pauses are very long; "Think Time" is a reminder to breathe and count to ten before potentially cutting off your student's train of thought. If your student is frustrated or if they have already given a thorough answer, move on!

Increasing Scale

Going Bigger

Now that your student is familiar with maps for their space, help them move on to maps that cover a larger area. Provide a map that shows the streets in your local vicinity (a printout from Google Maps would work for this). Put the map on the floor and help your student orient it so that the streets on the map go in the same direction as the real streets. Challenge them to pinpoint on the map the location of their home and other nearby locations they are familiar with, such as playgrounds, stores, friends' homes, etc. If there is a key for various symbols used on the map, show your student how to use it.

With the map on the floor and properly oriented, ask: "What direction should we go to get to ______ (another place indicated on the map)? Point!" With some coaching as needed, your student will catch on to the "trick." When the map is properly oriented, and they know their present location, the map shows the direction "as the crow flies" to anyplace else. For example, if they draw a straight line on the map from their present location to where they desire to go, that line shows the direction they should point. Of course, choosing available roads/paths to actually get there is another step.

As your student advances, a further step to take is to ask: How far is it? How long will it take us to get there? Using the scale of the map to translate map distance into real-world distance will only come with considerable practice and experience—or with actual measurements and math. Nevertheless, it is a good question to ask to get your student started on observing how relative distances can be estimated (and, later, calculated) from a map.

A key point in using a map to get to a desired location is knowing your present location and identifying that point on the map. It should be evident that if you don't know where you are, it will be impossible to know what direction you should go to get anywhere else, including home. Emphasize to your student that they

ACTIVITY NOTE

If your student would like to calculate the required time to get somewhere, they can do so by dividing the total distance that will be traveled (in miles) by an average walking speed of 3 miles per hour. For example, if they wanted to walk somewhere 6 miles away, it would take them approximately 6 miles ÷ 3 miles per hour = 2 hours.

ACTIVITY NOTE

Take advantage of opportunities for your student to put this skill into practice. For example, on visits to a museum, zoo, or park, pick up a copy of the map that is generally available. Coach your student, where needed, in orienting it, and then using it to guide you to exhibits, attractions, or sights.

Another opportunity to practice these skills is orienteering, a sport in which competitors use a map and compass to find checkpoints. Many areas have orienteering clubs that organize races, and some areas have permanent free courses installed in parks with maps you can download and use for practice. In the USA, visit orienteeringusa.org to find a local organization in your area.

should always find and mark their present position on a map before beginning and keep track of their progress, so they are always aware of their current position on the map. Only then will the map, oriented properly, show you which direction to go to get to the next location. If you wait until you are lost and don't know where you are, a map and even a compass will do you little good.

Using a map, challenge your student to guide you to a nearby location. This could be as simple as the next building over or as complex as a park several blocks and turns away. Provide them with a map of the area, and let them lead the way. Of course, keep an eye out for safety, and if they get too turned around, stop and help them reestablish where they are and how the map is oriented before stepping back for them to take the lead again.

Encourage your student to imagine and map their own island on Student Book page, "My Island." They may make an island for humans, for animals, or for imaginary creatures. Encourage them to think of important things to note at this scale, for example, types of terrain, bodies of water, locations of importance to any inhabitants, etc.

Behaviors & Environment

Adaptations

Returning to the examination and discussion of adaptations, two additional points should become evident and should be emphasized. First is that behaviors are just as important as physical attributes and need to be considered as a critical aspect of adaptation. The second is how adaptations, while providing an animal with abilities to meet its needs, also limit an animal to a particular climate and habitat, i.e., to a particular niche.

Adaptations Include Behaviors

A fun way to stress the importance of behaviors is to have your student imagine such things as a tree squirrel afraid to climb trees, a mouse afraid of small, dark holes, a fish who doesn't know how to swim, or a rabbit that can't stand the taste of vegetables. Let your student come up with and chuckle over further examples. The point that should become evident is that an animal must have behaviors that are in harmony with its physical adaptations. Otherwise, it is obviously in trouble.

In many cases, a behavior that adapts the animal is quite separate from any physical characteristic(s). For example, birds do not seem to have any physical adaptations that make them proficient at building nests. Yet they have the behavioral adaptation of doing so, and that adaptation has obvious benefits in rearing young. Living in a group (herd, tribe, hive, flock) has the advantage of providing protection for individual members, especially the young, and may also provide other advantages. Yet, there are no particular physical features involved in adapting an animal to live and interact in a group; living in the group is a behavioral adaptation.

Adaptations are Specific to Certain Habitat and Environment

Pose the question: If an animal species is highly adapted to feed on one sort of food and/or live in certain environmental conditions, what impact will that have on its ability to spread into regions where that food is not available or environmental conditions differ? (Think Time) If necessary, suggest a conspicuous example, such as fish. A fish is well adapted to the aquatic environment, but such adaptations also restrict it to the water environment. An-

other example might be polar bears. With heavy insulating fur, they are remarkably well adapted to the cold Arctic climate. However, this adaptation makes it impossible for them to survive in warmer climates; their warm coats make them too hot. Similarly, sun bears, with their less-heavy coats, cannot survive in the Arctic cold.

From here, let your student carry on by choosing particular animals and analyzing how their physical and behavioral features both adapt them particularly well to one sort of environment and, at the same time, preclude them from others. Your student has already seen this in the case of herbivores and carnivores, but further analysis of various animals may extend the theme further. Again, adaptations generally restrict an animal to a particular niche. A major part of the niche for any animal is the plant life that provides both food and habitat. Do plants exhibit adaptations as well? We will explore this more in the next session.

Have your student explore how adaptations and environment are related on Student Book page "Adaptations."

Evaporation

Where Does the Water Go?

While guiding your child to recall hanging things up or setting them out to dry, pose the question: Where does the water go as things dry? Your student may know the word "evaporate" and declare that the water evaporates. Answer: Yes, but what does that mean? Review as necessary that water, like all matter, is made up of particles/molecules too tiny to be seen individually. Where do the particles/molecules of water actually go?

Your student may have the notion that the particles/molecules of water simply disappear. If this is the case, ask questions such as: When you can't find a certain toy or your hat, do you think it simply disappeared? Or do you think it must be somewhere else? If it simply disappeared, would you even bother looking for it? Let your student give examples of losing things and finding them somewhere.

Continue this Q&A discussion far enough to bring your student to the generalization/conclusion that things don't just disappear or vanish. They go somewhere. Our task is to search for and find them. Emphasize that this is a basic truth for all of nature, science, and human society. Nothing just disappears; everything goes somewhere.

So, as wet things dry, where do the particles/molecules of water actually go? Ask leading questions, such as: Why do things dry faster when they are spread out and hung up? Why does a "wind" of warm air from a hair dryer make your hair dry faster? Will things dry if they are in a closed container? With such Q&A discussion, your student will begin to reason that particles/molecules of water are going off into the air. This is what we know as evaporation.

Ask your student: Can they design and conduct an experiment to test this idea of water particles/molecules going into the air? (Think Time) Use Q&A discussion to guide their reasoning in the direction: If water particles/molecules are going into the air, then exposing more surface area to the air should lead to faster rates of drying. Can they design an experiment accordingly? So far as feasible, let your student design and conduct their experiment, collect data, etc. One potential design is the following:

Pour an accurately measured quarter cup (about 60 milliliters) of water into each of the following containers: a covered container, a narrow drinking glass, a small bowl, and a dinner plate. Place them together in the same location (same conditions) and observe the rate of “disappearance” of water from each over the next day or so. The data your student collects from this or similar setups should reveal that the rate of “disappearance” of water is proportional to the surface area of the water exposed to the air of the room. If this is not the case, look for other variables, such as one container being exposed to more heat or a draft.

Your student can record the results of their experiment on Student Book page “Evaporation.”

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Student Book
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BDK

Read the examples of baloney and use your Baloney Detection Kit to show why they are baloney. Cut out the 9 included pieces of your Baloney Detection Kit below, then glue them under the baloney that they detect!

Saying something forcefully does not make it true
Every effect has a rational cause
One event following another does not mean that one caused the other
Inability to think of an alternative does not make a theory correct, nor does proving one idea wrong make another idea right
All data and/or observations must be considered
Beware of generalizing from specific to universal
Discard an argument that attacks the speaker rather than the data
Theories are not all equally valid
Inability to prove something false does not mean it is true

Rubber Bands

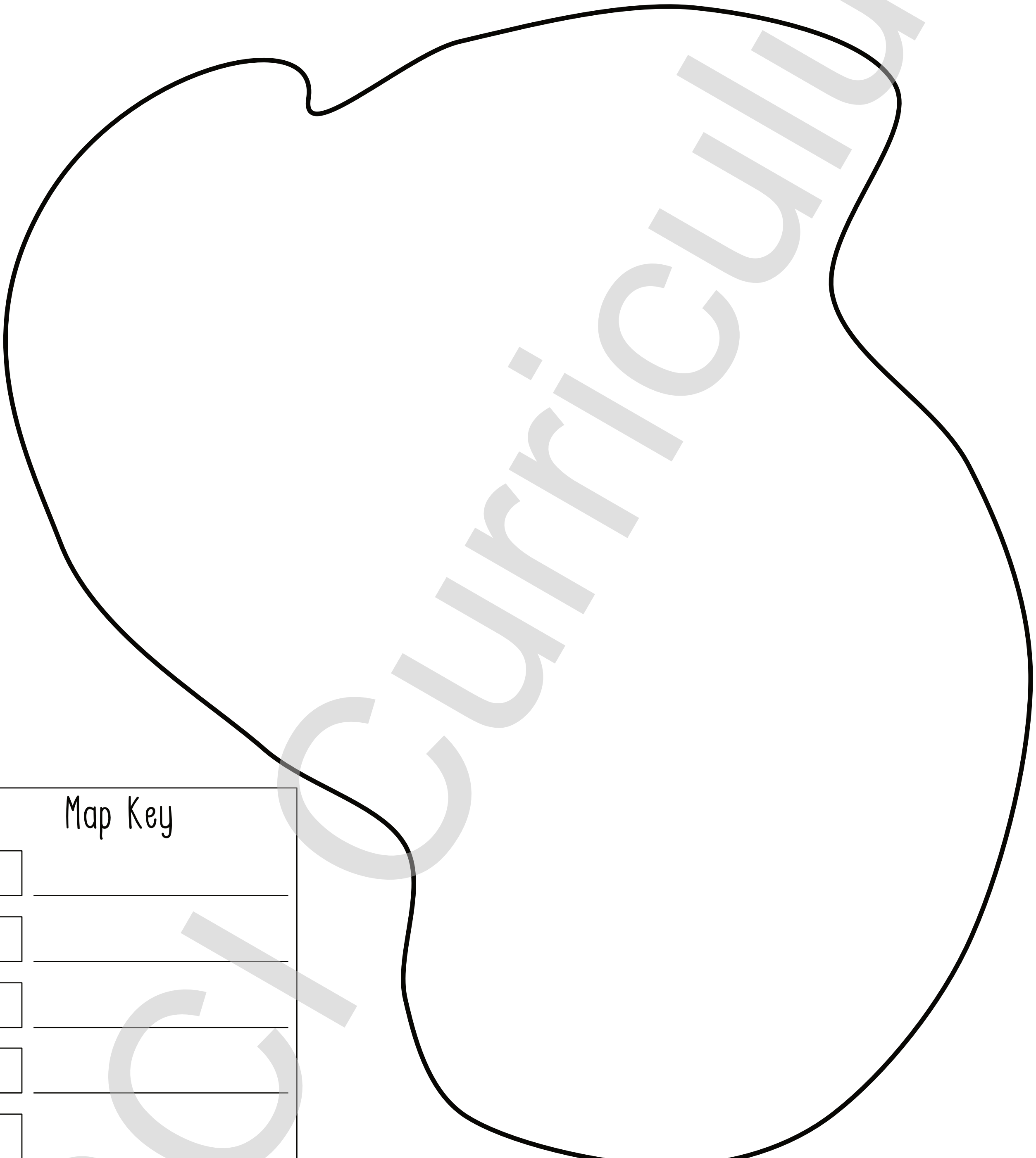
Variable What you changed	Results What happened

Variable What you changed	Results What happened

Variable What you changed	Results What happened

Variable What you changed	Results What happened

My Island



Map Key

Horse vs. Lion Jaws

Horse Jaw

Lion Jaw