

API® Lesson 5 | Aquarium Gravel

This lesson plan provides how to determine the amount and suggestions for determining the best type of gravel or substrate to select for an aquarium. Aquarium gravel and substrates provide benefits beyond appearance, their purpose and type are important to know prior to aquarium setup. This lesson will also help in understanding how and why keeping an aquarium clean is so important.

For Instructor/Teacher/Parent

Make sure to read through the entire lesson plan before beginning this with students/family members as materials may need to be purchased and information prep will need to be done. It is important to know what type of aquarium or types of fish are planned to reach a conclusion on aquarium gravel.

Learning Objectives

After completing the activities outlined in this lesson plan, students should be able to:

- Explain the different advantages of various gravel types.
- Determine the amount of gravel needed for a given size aquarium based on a given type of aquarium.
- Learn the benefits that gravel brings to the aquarium and/or fish types.
- Understand the importance of keeping the gravel bed clean.
- Determine the best substrate/gravel to select for your aquarium.

Length

This activity will take roughly 2 hours for completion.

Materials

- Basic Aquarium, Aquarium Cover, Aquarium Light, Aquarium Stand (if you have completed lesson 1, you will already have an aquarium set up, but changes might need to be considered like substrate/gravel upon completion of this lesson)
- Filter
- Heater (for tropical aquariums)
- API FRESHWATER or SALTWATER MASTER TEST KIT
- Water Conditioners and Bacterial Products
 - API STRESS COAT™ water conditioner
 - API QUICK START™ live nitrifying bacteria
 - API STRESS ZYME™ live cleaning bacteria
 - API LEAF ZONE™ plant fertilizer (for live planted aquariums)
 - API ROOT TABS™ plant fertilizer (live planted aquariums)
- Information source to understand Fish environments.



Key Terms

Review key terms (printable sheet included at the end of the lesson) for students/family members.

- 1) DOLOMITE
- 2) ARAGONITE
- 3) SAND
- 4) GRAVEL
- 5) LATERITE
- 6) NITRIFICATION
- 7) ENZYMATIC BACTERIA
- 8) TERRITORY (IN AQUARIUM TERMS)
- 9) SQUARE INCHES
- 10) SQUARE FEET

Warm Up

Ask a couple of questions to warm up for the lesson:

- What type of fish are you hoping to keep?
- Do you know where the fish you select are naturally found?
- How do the fish you select breed in their natural environment?
- Can you think of activities/actions from fish that would bother plants?

Before You Start

- 1) For this setup we are going to proceed using the basics from the tropical community aquarium ecosystem (see Lesson 1).
 - a) Note: It will be important to determine the type of fish in your aquarium or the aquarium you are designing.
- 2) You will need to make a list of fish types and determine the environment where they would naturally be found (refer here for help: <https://apifishcare.com/pdfs/api-lesson-1-community-aquarium-ecosystem-setup.pdf>).
- 3) You will need to understand the breeding requirements for the fish you are thinking of keeping (refer here for help: <https://www.thesprucepets.com/breeding-aquarium-fish-basics-4062067>).
- 4) You need to consider how your design would change with regards to gravel if you were keeping live plants (refer here for help: <https://apifishcare.com/post/fish-learning-fridays-planted-tank-set-up>).

Instructions for Learning Activity

1. Starting with the size of your aquarium

- a. Identify how many gallons the aquarium will hold.
 - i. To determine the size of your aquarium, measure the length, width and height in inches.
 - ii. Multiply the length by the width and then multiply by the height. $L \times W \times H =$ square inches of your aquarium
 - iii. To determine the gallons of your aquarium, divide the square inches by 231 to get your gallons.
- b. Identify the square inches of the bottom of your aquarium.
 - i. To determine square inches for the bottom of your aquarium measure the length and width of your aquarium
 - ii. Multiply the length by the width in inches to determine the bottom square inches of your aquarium. $L \times W =$ square inches.

2. Determine if gallons of the aquarium are a good judgement for aquarium gravel or substrate.

- a. A general statement often repeated is that a pound of gravel per gallon of water meets the aquarium requirements. So, a 20-gallon aquarium would require 20 pounds of gravel. Seems like a simple answer, now let's look at the size of a twenty-gallon aquarium.
 - i. You have a 20-gallon Long and a 20-gallon Tall. The dimensions of a 20-gallon Long are 30" x 12" x 12". The dimensions of a 20-gallon High are 24" x 12" x 16".
 - ii. **First determine the gallons for each standard 20-gallon aquarium.**
 - iii. **Determine the square inches for the bottom of each aquarium.**
 - iv. **Record your answers.**
 - v. We will come back to this example later.

3. Benefits of gravels or substrate

- a. **Aesthetics** - the main reason most people start an aquarium is to have a piece of nature in their home. The design and look of aquariums are a personal choice and every person has their own look and feel for the what they want. The bottom substrate enhances the final appearance toward that goal. It will enhance the look of your fish. The color of the gravel can also influence the appearance of your fish.
- b. **Soothing to the fish** - having a bare glass bottom aquarium can be stressful if the glass reflects the fish image back up to the fish. Fish often thrive best in a more natural setting and the substrate can help toward that goal.
- c. **Biological Balance** - beneficial Nitrifying Bacteria are essential to maintain a healthy water quality. These Nitrifying Bacteria convert toxic fish waste from ammonia to nitrite (also toxic) to non-toxic nitrate, this is referred to as the nitrogen cycle. The substrate is an ideal surface area for the bacteria to grow and keep your tank in proper balance.
 - i. Note: Add API QUICK START essential nitrifying bacteria. This kick starts the biological filter aka the Nitrogen Cycle. QUICK START contains the bacteria that convert poisonous ammonia (fish waste) into nitrite (also harmful to fish) and then into nitrate. API QUICK START ensures your biological filter is established, this process is called the nitrogen cycle or nitrification, and it occurs in all underwater ecosystems. These bacteria continue to grow as your aquarium ages - living on throughout the layers of the aquarium substrate.
- d. **For plants to grow** - most plants need a place for their roots to grow and hold them in place. The roots are essential for the plant to maintain growth. The roots will have fine hair-like structures that will uptake nutrients. The roots will anchor the plant in the aquarium so it will not float away. The substrate in the aquarium is the area where their roots grow and reach out for nutrients for the plant to stay green and lush. The substrate depth for planted aquariums should be at least 3" in depth.
- e. **Type of fish** - depending on the type of fish and activities, such as breeding, one type of substrate may be a better choice than another. Some fish like to sift through the substrate looking for food. One type of fish would include Kuhli loaches. As Kuhli loaches do not have scales any heavy gravel with sharp edges will harm them. For most loaches a finer gravel or sand is a good choice. As they like to burrow into the substrate the finer lighter varieties are the best choice. While many African Cichlids build nest in the substrate, so a thicker gravel bed is often preferred. African Cichlids come from areas with a higher pH and harder water, so a gravel that will help to raise the pH and buffer the water is the

preferred choice such as crushed coral or dolomite. African Cichlids are wide group while some will build a nest in the gravel other are shell dwellers, so research the type of fish you are keeping before determining which type and size of substrate is best for your fish.

- i. **Note:** Fish that swim in the upper water column either toward the surface or midwater are not as influenced as the type of gravel selected. Their appearance may be influenced as a result of the color selected. As an example, a darker colored fish may lighten in color when put against a light background or lighter colored gravel as they may try to blend in to camouflage themselves.

4. Types of aquarium gravel or substrate

- a. **Sand** - sand is available in a wide range of size from very fine grains to coarse material. Many fish types are naturally from areas where sand is found from the oceans to the Amazon Rio Negro. Sand has been used to meet the needs of fish to mimic their natural environments which could be sand, but also silt or even mud. As sand packs very tightly with little space between particles it is hard for uneaten food, organics like decaying plant material and fish waste to become trapped. Some fish will naturally burrow into the sand with less harm of damage that is more common with certain sharp stone edges. Sand will also limit flow and can easily become anaerobic, leading to water quality concerns. It can also be hard to siphon sand as it is much lighter than traditional gravel.
- b. **Crushed Coral/Dolomite/Aragonite** - these types of materials are desirable for fish that require a higher pH or water hardness are being kept. The major benefit is as these materials slowly dissolve; they buffer the water to prevent pH swings overtime. The particle size can be from 2mm and larger. These materials often contain sharp edges as they broken bits of coral or mined calcium carbonate rocks. These materials are not suitable for a planted aquarium as they alter the water chemistry in the wrong direction.
- c. **Large Pebble/Tiny Rocks/Coarse Gravel** - this group consist of the largest materials used in the bottom of aquariums. Typically, the particle size starts at 6 mm and larger. The larger size particles make it easy for debris to become trapped and cause water quality problems overtime in the aquarium. The trapped decaying material is a breeding ground for disease causing organism to grow and populate.
- d. **Common Gravel** - The typical particles of rocks, sizes are normally 2 to 5 mm (sometimes reference as a #2 or #3 size gravel). This is the most common first pick of new aquarists. It is available in a multitude of colors from natural browns to any color in the rainbow. The size makes it easy to clean through routine siphoning or gravel vacuuming of the aquarium.
- e. **Soil/Dirt/Peat** - These types of materials are often selected when setting up a planted aquarium. One of the major issues with these types of materials is their light density. The lighter density makes it easy for fish to dig into it cause cloudy water conditions. It is also hard to siphon during the routine maintenance. Peat materials are sometimes added to aquariums to soften or tint the water. If peat materials are desired it is best when used in the filter in a filter bag where it can be controlled. When used as a substrate or mixed into a substrate in the aquarium it is almost impossible to clean and is easily disturbed by fish causing cloudy water. Some will advise the use of these materials as a bottom layer in the aquarium with larger gravel or sand on top. That advise will work to start but when you siphon clean the aquarium you will see the lighter density of the materials in bottom layer are often pulled to the surface causing cloudy water and additional problems.
 - i. **Note:** If you have a strong desire to trial soil, dirt, or peat when growing plants in an aquarium you can place these materials into a small clay pot and then cover the top with common gravel. They you can place the filled clay pot with your plant into the aquarium and bury/hide the pot in a thicker gravel bed. The benefit of using a clay pot is that you can remove it for cleaning when necessary. Also, you will maintain the plants roots within the pot to control their spread throughout the aquarium.
 - ii. **Note:** some aquarium manufacturers do produce aquarium soils that are processed with colloidal materials that will hold their shape and maintain a higher density than dirt or soil alone. These materials specially designed for planted aquariums allow for siphoning and cleaning without the side effects of clouding the water.
- f. **Sintered Clay Gravel/Laterite Clay** - these are materials specially used for planted aquariums. Laterite comes in a wide variety of densities from very soft to very hard. The desire is to select a laterite that is moderate to very hard for your aquarium to avoid any concern such as cloudy water during cleaning. Laterite will provide nutrients for your plants slowly overtime. Sintered Clay materials are clays that have been fired to become a harder material. This material will also hold nutrients that your plant roots can uptake. The colors for sintered clay can be from a dull white to dark brown. Relying on any substrate to provide all the needed nutrients for your plants is not advised, as the plants will deplete any nutrients in the substrate overtime.

- i. **Note:** Fertilizing the root of your plants is key. Aquarium plants require certain essential nutrients for vibrant growth. If only a single nutrient or trace element is absent your aquarium plants will cease to grow. Feeding plants is easy today as modern fertilization compounds can provide these nutrients. It is best to fertilize both the roots and the leaves of your plants. Be sure to only select fertilizers specifically formulated for aquariums. Fertilizers designed for your garden or house plants should be ruled out as these often supply nutrients at levels that are dangerous to aquarium life.

- 1. To grow plants and keep your aquarium life safe add API ROOT TABS and API LEAF ZONE to feed your plants. Monthly add API ROOT TABS to the base of your plants pushing them midway into the gravel. API ROOT TABS are formulated to supply the key nutrients, including iron and potassium, to help new aquatic plants get off to a vigorous start and to keep established plants flourishing. ROOT TABS are fertilizer tablets designed exclusively for aquarium plants. When placed in the substrate/gravel on a monthly basis, ROOT TABS provide the essential nutrients aquarium plants need, absorbing nutrients through their roots. API Leaf Zone provides nutrients in liquid form that your plants can easily uptake through their leaves. Weekly additions of API Leaf Zone ensure fertilizers are available to your plants when they need them.

- ii. The substrate bed thickness should be at least 3 inches (7.6 cm). This will allow the roots to become established and spread appropriately to uptake nutrients.

- g. **Marbles/Glass** - Marbles are commonly used in small containers, especially with Bettas. They are easy to clean and do not alter the water chemistry. Another use for marbles as a substrate in larger aquariums is when breeding certain egg scattering fish such as danios, corys and white clouds. Egg scattering fish will often eat the eggs as soon as they are fertilized. The marbles allow the eggs to drop into the spaces between the marbles keeping them away for the adult fish. Once the eggs hatch if the adults are still in the same aquarium the fry (baby fish) can continue to avoid the parents. It is always advised when possible to remove the parents to another aquarium after breeding allowing the young fish the ability to grow to their fullest potential.

5. Routine Care and Maintenance

- a. Overtime your substrate will become filled with organic debris from fish waste, decaying plant material, dead algae, and uneaten fish food. If left unchecked your aquarium water quality will decline.
 - i. A best practice in aquarium care is to perform partial (20 to 25%) water changes every 2 to 3 weeks perform. When performing a water change it is advised to siphon clean or vacuum your substrate/gravel. This will remove much of the organic debris.
 - 1. Note: Remember replacement water from tap water needs to be treated to remove toxic chlorine and chloramines and reduce heavy metals. Always remember to treat the water you are adding with API STRESS COAT to make it safe for your fish. Routine water changes are the best way to prevent most problems that could occur. Routine water changes will help to decrease any accumulation of nitrate and phosphate over time.
 - ii. Cleaning enzymatic bacteria aids further in keeping your aquarium clean and healthy - Add API STRESS ZYME weekly to help keep your aquarium clean. Stress Zyme contains five different strains of beneficial bacillus bacteria that digest uneaten fish food, fish waste, decaying plant materials and other organic matter. The bacteria in STRESS ZYME were specifically selected for their unique ability to consume organic matter that accumulates in aquariums. The beneficial clean-up bacteria in Stress Zyme will reach areas in the gravel that routine siphon cleaning may miss. Regular additions of Stress keep your aquarium cleaner and reduce the overall maintenance needed.

6. Determining how much gravel or substrate is needed

- a. The overall density of the substrate will vary but in general sand is denser than regular aquarium gravel. So, if you are selecting sand you will need more pounds to obtain the same depth than if you were using gravel. The overall gallons of your aquarium are not a good judge for how much substrate you will need.
 - i. Rule of thumb to follow is to look at the bottom surface area of your aquarium.
 - 1. Aquarium Gravel - For every 1 inch (2.54 cm) you will need 5.33 lbs/square foot (2.4 Kg/square cm) of aquarium gravel.
 - 2. Aquarium Sand - For every 1 inch (2.54 cm) you will need 8.0 lbs/square foot (3.629Kg/square cm) of aquarium sand.



- b. As an example; the aquarium is 72" Long X 24" Wide X 30" Height (182.88 cm L x 60.96 cm W x 76.2 cm H) , how much gravel should you buy to obtain a 2" (5.28 cm) thick gravel bed?
1. First determine the square inches of this aquarium - L X W (72" x 24") = 1,728 square inches (182.88 cm x 60.96 cm = 11,148.4 square centimeters)
 2. Convert square inches to square feet - 1,728 divided by 144 = 12, bottom layer of aquarium measure 12 square feet. (11,148.4 divided 929.08 [Square centimeters per square foot] = 12)
 3. 12 X 5.33 pounds (2.418 Kg) per square foot = 63.96 pounds (29 Kg) of gravel for 1 inch (2.54 cm) of depth.
 4. 63.96 pounds 29Kg) X 2 = 127.96 pounds (58Kg) of gravel to obtain a 2" (5.08 cm) gravel bed in your aquarium.
- c. Now using the square inches that you calculated earlier of your aquarium, how many pounds of gravel are needed in your aquarium to obtain a 2" gravel bed?
- i. How many pounds are needed to obtain a 3" gravel bed in your aquarium?

Note: Always purchase any substrate that is manufactured and designated that it is safe for aquarium fish. Always rinse your gravel to remove fine particles and dust before placing it in the bottom of the aquarium.

Discussion

- After finishing the items above including reviewing key terms, engage students/family members in a brief discussion about the lesson:
 - Why is the type of gravel important?
 - Show students pictures of different types of gravel to help them understand the pros and cons of each.
 - Why does the aquarium overall volume (gallons or liters) not matter in determining the amount of gravel for an aquarium?
 - Why are bacteria important?
 - Describe two types of bacteria that function in the gravel bed.

Quiz

- Once you've finished the discussion, pass out the Quiz worksheet (printable sheet included at the end of the lesson) to each student/family member.
 - Have them complete the quiz and then review the answers/have an open discussion about the answers with them. Answers are below.
1. Does the gallonage of the overall aquarium influence the amount of gravel you would buy?
 - Answer: NO, it is only the square of the bottom layer that influences the amount of gravel you need.
 2. How much gravel is needed to have 3 inches in depth for an aquarium that is 24 inches long and 24 inches wide and 48 inches tall?
 - Answer: 64 pounds
 - Process $24" \times 24" = 576$ sq. inches
 - $576 \div 144 = 4$ sq. feet
 - $4 \times 5.63 = 21.32$ pounds of gravel for inch depth
 - $21.32 \times 3 = 63.96$ pounds of gravel for 3 inches, rounded to 64 pounds
 3. True or False
 - Plants can obtain all the nutrients they need from gravel.
 - False - overtime the gravel will be depleted of nutrients and fertilizers must be added.
 - Marbles should not be used in aquarium as a substrate.
 - False - marbles can be used.
 - Crushed Coral used in freshwater will provide a higher pH and buffer the water.
 - True - crushed coral slowly dissolves and will buffer the water.
 - One pound of sand takes up more volume than one pound of gravel.
 - False - sand is denser, so sand takes up less volume than gravel
 4. Name two benefits that substrate or gravel provide in the aquarium.
 - Answer: Aesthetics, soothing the fish, home for bacterial growth, area for plants roots to attach to, creates/mimics conditions for fish to bred and feed.

Additional Support Information

1. **How big is the aquarium?** If you bought it new the packaging would have indicated the size. It is important to know the size of your aquarium to know how much to of any product to treat with or when determining gallons when performing a partial water change during routine maintenance.
 - o One gallon of water contains 231 cubic inches. If you measure your aquarium in length, width and height in inches then multiply then the divide by 231 you get an answer in gallons. An example is a standard 15-gallon aquarium measure 12" x 12" x 24". When you multiply these numbers, you will get 3,456 then when you divide this number by 231 you will get 14.34 gallons. So now you can see the average 15-gallon aquarium holds 14.34 gallons.
2. **Decorations are not just for you to look at!** Decorations in an aquarium should serve a benefit for the type of fish being kept. Some fish naturally like to hide in plants or under rocks. Some will be very active, and others will seem to lie around. Some fish are naturally active at night while others will be out during the day. Each type of fish has habits that are unique to their type of fish. When you first enter fish into any aquarium they are stressed and will need time to acclimate. Providing them with different decorations to meet their specific needs helps them to adjust to their new home.
3. **The Nitrogen Cycle is important.** The fish produce waste from their gills and fecal matter in the form of ammonia. A chemist would write ammonia as NH_3 , that is nitrogen and hydrogen. The beneficial nitrifying bacteria consume/converts the ammonia from NH_3 to NO_2 this is called nitrite. Both ammonia and nitrite are bad/toxic for fish. In nature another beneficial nitrifying bacteria consumes/converts the NO_2 (nitrite) to NO_3 (nitrate). Nitrate is safe but not in large amounts. When you make routine water changes the nitrate is diluted.

The chemical process from NH_3 to NO_2 to NO_3 is called the nitrogen cycle. To determine the success of your nitrogen cycle, test your water using the API Master Test Kit. Add API Quick Start provide the nitrifying bacteria important for nitrogen cycle. As the fish produce more waste more bacteria are needed to maintain the proper balance. Over the first few weeks after setting up your aquarium the nitrogen cycle is becoming established. When the ammonia and nitrite remain at zero your nitrogen cycle is considered established and functioning properly.

4. **Algae is expected in any aquarium.** Algae is not harmful in aquariums, but it is not always something we may want to see as it takes from the serene setting. Algae attaches to the glass, rocks, gravel and decorations. If you scrap it away from the glass, you can then remove it. You can buy fish that will eat it, *Otocinclus* catfish another smaller algae-eating fish. You can also buy algae removing water treatment such as API ALGAEFIX™. API ALGAEFIX is a plant safe algacide.
5. **Fish need a balanced and complete diet.** In nature fish eat whenever they are hungry and often rely on eating live food. Things change when they are kept in aquarium setting. Fish need the some of the same things we do proteins, carbohydrate, vitamins, minerals and fats. Providing these in the correct balance is important because feeding too little is bad for them and feed to much will pollute their environment. API Fish Food have been formulated to provide your fish with all the ingredients fish need in the correct balance.

Feed your fish once or twice a day that amount they will consume in a few minutes. The food should be completely eaten. Over feeding will cause cloudy water and produce more ammonia in the water. Any food that is not eaten that is left over decays on the bottom and pollutes the water even more. Feeding is a good time to check your fish. Watch them carefully to make everyone is eating. Observe them to assure their fins and body are in proper condition. Observe their behaviors and colors.

6. **Choosing fish for a planted aquarium.** Many fish have a selected area that they prefer to stay in, the upper region, mid region or bottom region of the aquarium. Fish such as the hatchet fish, danios, Congo Tetras, Rasboras, Platies are fish types that swim higher in the aquarium. Fish such as gold barbs, glow-light tetras, rummy-nose tetras, neon tetra are example that stay in mid water of the aquarium. And fish such as *Corydoras* catfish, *Otocinclus*, *kribensis*, dwarf ram cichlids are fish that primarily stay on the bottom.

KEY TERMS

DOLOMITE

A calcium magnesium carbonate rock. It is crushed to suitable sizes for aquarium use. It very slowly provides buffering of the water and calcium and magnesium as well as carbonate ions.

ARAGONITE

A calcium carbonate predominate rock. It is crushed to suitable sizes for aquarium use. It very slowly provides buffering of the water mostly with calcium and carbonates.

SAND

Fine debris from shells, rocks, corals, etc. consisting of small, loose grains.

GRAVEL

Small pieces of rock and pebbles larger than grains of sand, typically 2 to 4 mm in size.

LATERITE

Consisting of either clay or rock material that is rich in iron.

NITRIFICATION

Biological oxidation (reduction) of ammonia to nitrite and then nitrite to nitrate. Most often the biological oxidation is from nitrifying bacteria.

ENZYMATIC BACTERIA

Bacteria that utilize enzymes to degrade proteins (organics) into amino acids.

SQUARE INCHES

Equal to the area of a square with the sides equal to one inch.

SQUARE FEET

Equal to the area of a square with the sides equal to one foot.

QUIZ

1. Does the gallonage of the overall aquarium influence the amount of gravel you would buy?
2. How much gravel is needed to have 3 inches in depth for an aquarium that is 24 inches long and 24 inches wide and 48 inches tall?
3. True or False
 - Plants can obtain all the nutrients they need from gravel.
 - Marbles should not be used in aquarium as a substrate.
 - Crushed Coral used in freshwater will provide a higher pH and buffer the water.
 - One pound of sand takes up more volume than one pound of gravel.
4. Name two benefits that substrate or gravel provide in the aquarium.

TYPES OF GRAVEL/SUBSTRATE

SAND



CRUSHED CORAL



DOLOMITE



ARAGONITE



LARGE PEBBLE/TINY
ROCKS/COARSE GRAVEL



COMMON GRAVEL
MULTI-COLORED



TYPES OF GRAVEL/SUBSTRATE

COMMON GRAVEL
NATURAL COLORED



SOIL/DIRT/PEAT



SINTERED CLAY GRAVEL



LATERITE CLAY



MARBLES/GLASS



CONTACT US & ADDITIONAL RESOURCES

For more information regarding this lesson plan, API® brand, or any general fishkeeping questions and/or comments, feel free to contact us below.

- Website: <https://apifishcare.com/>
- Telephone Number: 1-800-847-0659