Two Little Fishies Aquariums
2929 Damselfish Lane
Oceanview, FL 99999

June 21, 2021

Smith Junior High School Administration
629 Educator Drive
Oceanview, FL 99999

Dear Smith Junior High School Administration and Faculty:

In response to queries submitted to the Two Little Fishies Aquariums store by teachers of the Smith Junior High School's Science Department, I am enclosing the following recommendation report: *Saltwater Reef Aquarium Kit for Smith Junior High School Science Lab*.

This recommendation report shall assist the staff in selecting a new aquarium suitable for maintaining a miniature saltwater reef ecosystem as part of the science lab curriculum. The report examines three moderately priced aquariums that meet the requirements provided by the instructors that share the science lab.

Please advise if I can be of further service in assisting you with the selection and upkeep of your new aquarium.

Sincerely,

Bob Blue
Two Little Fishies Aquariums Owner

Enclosure: Recommendation Report

Recommendation Report:
Saltwater Reef Aquarium Kit for
Smith Junior High School Science Lab

The new 2021-2022 science curriculum includes several units that address diverse ecosystems, including the world's oceans. The purpose of this report is to assist Smith Junior High's administration and science faculty in the selection of a beginner saltwater aquarium kit for the 8th-grade science lab.[1] This aquarium will provide hands-on learning opportunities for the students as they build, study, and care for the living organisms within this miniature ecosystem.

Aquarium kits are available in a wide variety of shapes and sizes. In addition, kits include options that make the aquarium suitable for different purposes, such as supporting soft or hard corals, fish only, or a combination of fish and live rock (refer to Aquarium Terminology). This report compares three aquarium kits and addresses the following requirements in order of importance as provided by the science lab faculty: (1) tank size and material, (2) lighting, (3) filtration, (4) pump, (5) accessories, and (6) cost.

Aquarium Terminology

Filtration. The method by which organic waste products are removed from the aquarium. Reef aquariums usually use a combination of biological, mechanical, and chemical filtration techniques:

- *Biological Filtration. T*he use of "good" bacteria and other organisms, such as those that inhabit live rock and sand, to consume wastes such as ammonia, nitrates, and nitrites in the aquarium. Cleaner animals, including snails and filter feeders, are also valuable parts of biological filtration.
- *Mechanical Filtration.* An electric filter that uses floss, sponges, or other media to capture food particles and other solid wastes and remove them from the aquarium.
- *Chemical Filtration.* Carbon or chemical resins used to pull toxins from the aquarium water.
- *Protein Skimmers.* Type of filtration that removes dissolved organic waste. See Figure 1 to view an image of a protein skimmer. [1]

Gallons Per Hour (GPH). The number of gallons that an aquarium pump circulates every 60 minutes.

Hydrometer. Device that measures specific gravity levels for the water in an aquarium.

Lighting. Light ballast and lights that are installed either: (1) in the ceiling above a reef aquarium, (2) on top of a glass top of an aquarium, or (3) mounted in the canopy or hood (top) of an aquarium. Aquarium lighting exists in many different forms, such as metal halide, fluorescent, or LED.

Live Rock. An umbrella term used to describe broken-off pieces of coral reefs, aragonite formed from dead coral skeletons, or artificial substances such as concrete. Natural live rock is harvested from the ocean or an existing reef aquarium, while man-made substances are seeded from existing live rock. Live organisms, such as microscopic bacteria, algae, and invertebrates, colonize the rock surface and its crevices. Live rock functions as a form of natural, biological filtration in the reef aquarium. [2]

[1] The intended audience for this document is the Smith Junior High School administration and science class faculty who will be voting on the best aquarium to purchase for the science lab. The administrators are expected to have limited or no knowledge regarding the subject of reef aquariums, while the science class faculty have researched the topic, have a good understanding of the reef-keeping process, and have provided the list of requirements.

Live Sand. Sand gathered from the ocean or seeded from an existing aquarium contains beneficial bacteria and organisms. The sand is harvested and placed in saltwater aquariums to function as a biological filter to reduce wastes such as ammonia, nitrates, and nitrites in the water column. [3]

Protein Skimmer. Mechanical, cylindrical filtration that removes dissolved organic waste such as food and fish waste from aquarium water by mixing air and waste to create a foam and skim it from the water column. This process occurs naturally in the ocean when crashing waves mix air and wastes that produce foam that collects on the beach. [4] Figure 1 shows a protein skimmer integrated into the plumbing system of a large reef aquarium.

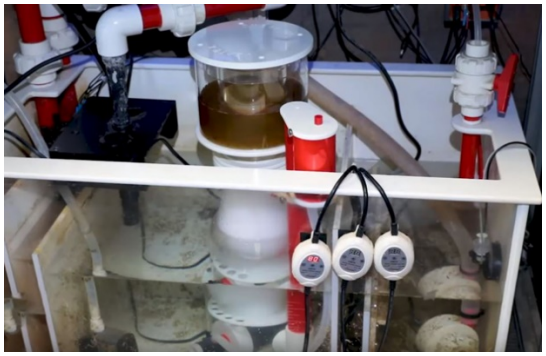

Figure 1. The protein skimmer in this image shows waste collected in the top chamber of the skimmer and the foam generated by the skimmer to separate the waste from the water in the lower chamber. [4] In this setup for a large tank, the skimmer sits in a sump, part of the plumbing hidden underneath the aquarium in a covered cabinet or separate room.

Pump. A mechanical device that circulates water in the aquarium. It creates constant motion and water flow within the aquarium to mimic ocean waves and current and provides a means to push waste in the water column through the mechanical filter systems.

Reef aquarium. A saltwater aquarium that displays a variety of corals, other invertebrates, and marine fish. A reef aquarium replicates an ocean reef. Figure 2 is an illustration of a reef aquarium.

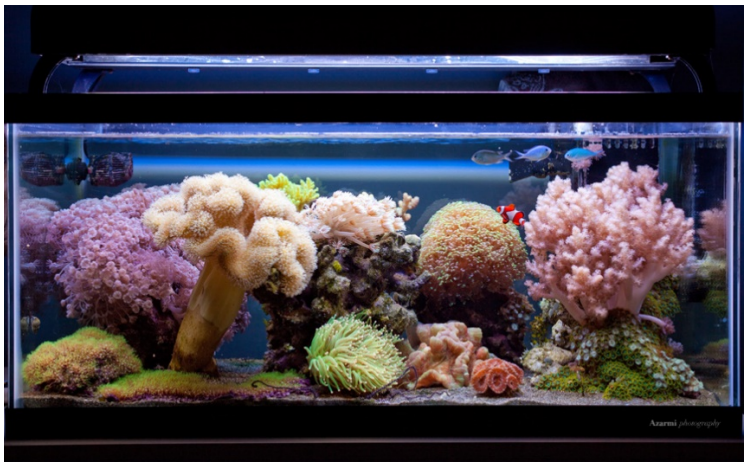

Figure 2. A 40-gallon reef tank containing an assortment of live rock, live sand, soft corals, and fish. [5]

*Soft Corals. C*orals that do not have a hard skeleton but do contain some bony elements (sclerites). Many individual animals live in a colony that makes up a single coral. Because they do not have a hard skeleton, these corals bend and sway in the water current. Soft corals absorb nutrients from the water or feed on nanoplankton. In the aquarium trade, soft corals are "beginner corals" because they require lower light levels than their stony coral counterparts. [6] Figure 2 is an illustration of a reef aquarium that contains a variety of soft corals.

Tank. The main body of the aquarium holding the livestock. Figure 2 shows a fully functional reef tank similar to one the science faculty will use in educating Smith Junior High students on ocean ecosystems.

Turnover Rate. The number of times the entire water volume of the aquarium circulates. For reef tanks, you determine the actual turnover rate in GPH using *tank volume x turnover = GPH*. For example, 30g (gallons) x 20 (turnover rate) = 600 GPH. The optimal turnover rate for a reef aquarium falls within 10 to 20 times the total volume of water in the aquarium tank. [7]

Aquarium Brands and Models

Three different models of aquariums, manufactured by two different companies, have been selected for this comparison: (1) The M60 Fluval Reef Aquarium Set includes a 24-gallon glass aquarium, light emitting diode (LED) lighting, protein skimmer, pump, and other accessories with a unit cost of $770.00, (2) the Fluval M90 Reef Aquarium Set comes with a pre-drilled, 36-gallon glass aquarium and is equipped with the major components needed for a reef aquarium at a unit price of $1000.00, and (3) the Coralife LED BioCube 32 Aquarium Ultimate Reef Bundle comes with a 32-gallon aquarium with LED lighting and sells for $870.00 per unit.

Aquarium Kit Requirements

The science teachers at Smith Junior High School share the science lab. After some discussion, they have submitted the following requirements for the new aquarium:

- The tank for the aquarium must be at least 20 gallons in size to accommodate multiple organisms and promote water chemistry stability.
- The tank must be made of glass.
- Lighting must support soft corals and other marine life such as fish, tube worms, crabs, shrimp, and snails.
- Biological, chemical, and mechanical filtration must be hidden either behind the tank itself or in a cabinet. The inclusion of a protein skimmer is desirable.
- Water pump size must be compatible with the overall size of the tank to circulate sufficient gallons per hour (GPH) to equal turnover between 10 to 20 times the tank volume each hour.
- Accessories for the aquarium should include, at minimum, a stand on which the aquarium will sit.
- Price must not exceed $1200.00.

Aquarium Kit Comparison by Features

Saltwater reef aquariums can be an exciting learning tool. Thanks to advancements in aquarium technology, bringing a small part of the ocean into the classroom is possible. The following discussion highlights the advantages and disadvantages of a small selection of reef aquarium kits suitable for beginner-level coral reef and marine aquarium enthusiasts.

- **Tank Size.** When starting a reef aquarium, it is important to purchase the largest tank that fits within your budget. The larger the aquarium, the easier it is to maintain optimal water conditions. Salinity, calcium, alkalinity, ammonia, PH, magnesium, and phosphate levels are critical to your aquarium inhabitants' continued health and happiness. All kits in this comparison exceed the minimum 20-gallon requirement. Fluval manufactures both the Fluval M60 and M90 tanks as four glass panes bound together by silicone sealant. The sealant disrupts the view of the inside of the tank. [10] The Fluval M60 kit offers a smaller, 24-gallon tank size. [11] The Fluval M90 kit offers the best size tank.
- **Tank Material.** Aquarium tanks are constructed of either glass or clear acrylic. The science teachers require that the classroom tank be made of glass, as acrylic tanks scratch more easily and discolor over time. All three of the tanks reviewed in this recommendation are made of glass and meet this requirement. The Coralife BioCube has a curved glass front. Unlike most other glass tanks, it does not require silicone to hold the two glass sides to the front glass plate. This design provides a full panoramic view of the tank inhabitants.[10] Both the Fluval M60 and the M90

are comprised of four panels of glass that are held together by silicone sealant, disrupting the view of the inside of the tank. [9] The Coralife BioCube has the advantage in this category due to the configuration of the glass.

- **Lighting.** Due to the long life of LED bulbs and their low heat output, LED lighting has become a fast-growing trend for home aquariums. All three kits selected for review come equipped with this type of lighting:
  - The Fluval M60 and M90 models include a Fluval Sea Marine & Reef Full Spectrum Performance LED adjustable-length strip light. Strip lights are versatile and can be placed directly on a glass aquarium lid, added to a canopy, or hung from a ceiling above the tank. The lights included with the M60 are adjustable from 24 to 34 inches in length and feature 312 LEDs. [9] The M90 kit contains a longer light to accommodate its larger tank size. The length of the light is adjustable from 36 to 46 inches in length and features 504 LEDs.[8] The strip lights have three settings: (1) day, (2) night, and (3) off. Specifications for this lighting indicate it can support soft corals. [8; 9]
  - The Coralife BioCube lighting is built directly into the aquarium hood, providing a modern appearance. This lighting is suitable for growing a small assortment of soft corals with low light requirements.[10] The BioCube has a built-in programmable timer to assist in running sunlight and sunset and moonrise and moonset simulations. [11] It does not specify the number of LEDs provided.

  The Fluval M90 kit prevails in this category due to the number of LEDs and the ability to support corals that require additional light. Although the BioCube offers in-hood lighting and a timer, you must also consider whether it is easier to replace a full hood or strip lights should a ballast fail. If ballast failure occurs, you may have to discard the hood and purchase a replacement lighting system for the tank.

- **Filtration.** The Fluval M60 and M90 aquarium kits are designed with integrated compartments to contain a mechanical filter, protein skimmer, and a pump. The design conceals plumbing behind the tank or underneath it in the accompanying stand. Each model also includes a small protein skimmer and a filter pump but no other filter or filter media. [8; 9] A review of these skimmers indicates that they produce undesirable microbubbles in the tank, and instructions for use are unclear. [12]. The Coralife BioCube design incorporates a customizable filtration chamber. This model includes dual water intakes, media basket, sponge (pump pre-filter), and carbon filter cartridge. The kit also provides a small protein skimmer explicitly designed for use in the BioCube line of aquariums. [11] The Coralife BioCube is the preferred aquarium kit for this category. It provides both a protein skimmer and other filter media. It also meets the requirement of hiding the plumbing behind or beneath the tank.

- **Pump.** Both the Fluval M60 and M90 aquarium kits include the same circulation pump. The Fluval Sea CP1 Circulation Pump processes 265 GPH, meaning that the turnover rate for the 24-gallon Fluval M60 is 11, just barely over the lower end of recommended turnover for a reef aquarium.[13] The turnover rate in the 36-gallon M90 is a little over 7, under the recommended rate of turnover for this size aquarium. The Coralife BioCube comes with a Hydor Aqamai KPS Wi-Fi Controllable Wavemaker Pump with an adjustable flow rate from 350 GPH to 1050 GPH. [14] This rate of turnover, an 11 at its lowest end and a 32 at full power, far outpaces performance of the Fluval kits, making it the leader in this category.

- **Accessories.** All aquarium kits in this assessment meet the requirement of including an aquarium stand as an accessory. The Fluval kits do not offer any additional accessories. The Coralife LED BioCube kit comes with an astonishing number of extras, including a thermometer, a hygrometer, water test kits, enough salt mix for 30 gallons of water, 12 pounds of reef sand, and more, making it the best option for this category.[10]

- **Cost.** The Fluval M60 Reef Aquarium Set is the lowest-priced item in this comparison at $770.00. The Coralife LED BioCube is the mid-priced option at $870.00, followed by the Fluval M90 Reef Aquarium Set at the highest price of $1000.00

Table 1. is a summarization of contents for each aquarium kit in this recommendation report:

Table 1. Reef Aquarium Kit Comparison			
Category	**Fluval M60 Reef Aquarium Set**	**Fluval M90 Reef Aquarium Set**	**Coralife LED BioCube 32 Aquarium Ultimate Reef Bundle**
Cost	$770.00	$1000.00	$870.00
Tank Size	24 Gallons	36 Gallons	32 Gallons
Tank Material	Glass and silicone	Glass and silicone	Curved Glass
Lighting	Supports soft corals with low-to-mid-level light requirements	Supports soft corals with low-to-mid-level light requirements	Supports soft corals with low light requirements
Filtration (performance)	Fair	Fair	Good
Pump (turnover rate)	Average	Below Average	Above Average
Accessories:	Meets requirement	Meets requirement	Exceeds requirement

Conclusions

Based on the comparison of features in each reef aquarium kit listed in Table 1, the following are the conclusions for this recommendation report:

1. The Fluval M90 is the most expensive of the kits reviewed, while the Fluval M60 is the least expensive. The Coralife BioCube price places this aquarium in the median price range.
2. At 36 gallons, the Fluval M90 Reef Aquarium Kit offers the best size for a beginner reef aquarium by providing the maximum range of forgiveness for water parameter fluctuation.
3. The Coralife BioCube provides an optimal, unobstructed view of aquarium inhabitants.
4. The lighting included with both Fluval kits outshines the competition by its ability to support soft corals in the low-to-mid-level lighting requirement range.
5. The Coralife BioCube provides the best filtering option with its protein skimmer and containment system that hides the unit's plumbing behind the tank.
6. The Coralife BioCube blows the competition away with its adjustable flow that can provide a turnover rate at a maximum flow rate of over 32 times the aquarium volume.
7. The Coralife BioCube meets the requirement of providing an aquarium stand and offers many of the essential reef-keeping accessories that students and instructors will need in the classroom.
8. Based on the conclusions described in this report, the Coralife BioCube is the best aquarium for purchase.

Recommendation

Based on the comparisons in this report, I support the selection of the Coralife LED BioCube 32 Aquarium Ultimate Reef Bundle. This aquarium kit's mid-level price range, lighting, overall performance, and inclusion of multiple accessories needed to start up the aquarium make it the best choice for the Smith Junior High School Science Lab.

References

[1] Barrington, Kate. "Saltwater Aquarium Filtration" October 16, 2020 [accessed June 17, 2021] https://www.ratemyfishtank.com/blog/saltwater-aquarium-filtration

[2] Atlantic Reef Conservation (ARC Reef). "Live Rock – The Ultimate Guide" N.d. [accessed June 20, 2021] https://arcreef.com/live-rock/live-rock-guide/

[3] Wikipedia. "Live Sand" November 14, 2020 [accessed June 20, 2021] https://en.wikipedia.org/wiki/Live_sand

[4] Bulk Reef Supply. "Protein skimmer guide - Explaining what they do and how they work - Reef FAQ" N.d. [accessed June 20, 2021] https://www.bulkreefsupply.com/content/post/protein-skimmer-guide-explaining-what-they-do-and-how-they-work-brstv-reef-faqs

[5] Razarmi, Nano Reef.com. "Nano Reef Journals" December 19, 2011 [accessed June 18, 2021] https://www.nano-reef.com/forums/topic/289043-rods-40g-soft-coral-reef-aquarium/

[6] Ulrich III, Albert B. "Soft Corals: How to care for soft corals in a saltwater aquarium" N.d. [accessed June 17, 2021] https://www.saltwateraquariumblog.com/soft-coral/

[7] Krenzer, John. "A Complete Guide to Flow for Reef Aquariums" N.d. [accessed June 17, 2021] https://reefstable.com/blog/determine-flow-rate/#:~:text=The%20needed%20flow%20rate%20for,of%20flow%20at%20a%20minimum

[8] Live Aquaria. "Fluval M-90 Reef Aquarium Set" N.d. [accessed June 17, 2021] https://www.liveaquaria.com/product/6008/fluval-m-90-reef-aquarium-set?pcatid=6008&c=3753+3829+3830+6008

[9] Live Aquaria. "Fluval Reef Aquarium Set" N.d [accessed June 17, 2021] https://www.liveaquaria.com/product/4645/fluval-reef-aquarium-set?pcatid=4645&c=3753+3829+3830+4645

[10] Salt Tank Report, Saltwater Aquarium Blog. "9 Best Corals for BioCube 32 Aquarium" N.d. [accessed June 20, 2021] https://salttankreport.com/best-corals-for-biocube-32-aquarium/

[11] Marine and Reef. "Coralife Size 32 BioCube Aquarium Ultimate Reef Package" N.d. [accessed June 17, 2021] https://www.marineandreef.com/Coralife_BioCube_DELUXE_COMPLETE_PACKAGE_p/RES95667.htm?gclid=CjwKCAjwzruGBhBAEiwAUqMR8NFNghgrk4Ud4VaZ01hn1vT1rVdo9b0JRJnwBXJyvGN_RD5uphy6thoCXMwQAvD_BwE

[12] Thynne, Anne. "Fluval Sea Protein Skimmer Review" September 12, 2020 [accessed June 17, 2021] https://expertaquarist.com/fluval-sea-protein-skimmer-review/

[13] Fluval. "CP1 Circulation Pump" N.d. [accessed June 21, 2021] https://fluvalaquatics.com/us/product/cp1-circulation-pump/

[14] Marine and Reef. "Hydor Aqamai KPS Wi-Fi Controllable Wavemaker Pump, 1050 GPH" N.d. [accessed June 17, 2021] https://www.marineandreef.com/Hydor_Aqamai_KPS_Wi_Fi_Controllable_Wavemaker_Pump_p/rhy01181.htm