

माध्यमिक तहमा STEM Lab

(Science, Technology, Engineering and Mathematics)

स्थापना र सञ्चालन सम्बन्धी मार्गदर्शन, २०८३

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गण्डकी प्रदेश सरकार

सामाजिक विकास, युवा तथा खेलकुद मन्त्रालय

पोखरा ।

प्रकाशकीय

गुणस्तरीय, समावेशी तथा प्रविधिमैत्री शिक्षा आजको शिक्षाको प्रमुख आवश्यकता हो । विज्ञान, प्रविधि, इन्जिनियरिङ तथा गणित (Science, Technology, Engineering and Mathematics - STEM) मा आधारित प्रयोगात्मक अभ्यास सहितको शिक्षाले विद्यार्थीमा मनोवैज्ञानिक सोच, तार्किक विश्लेषण, सृजनशीलता, नवप्रवर्तन, समस्या समाधान क्षमता तथा अनुसन्धान संस्कृतिको विकास गर्न महत्वपूर्ण भूमिका निर्वाह गर्दछ। विश्वव्यापी रूपमा शिक्षा प्रणाली परियोजनामूलक तथा प्रविधिमा आधारित सिकाईतर्फ उन्मुख भइरहेका सन्दर्भमा राष्ट्रिय पाठ्यक्रम प्रारूप, २०७६, राष्ट्रिय शिक्षा नीति, २०७६ तथा गण्डकी प्रदेश शिक्षा नीति, २०७८ ले विद्यालय शिक्षामा विज्ञान तथा प्रविधिको प्रभावकारी उपयोग, अनुसन्धानमूलक सिकाई, नवप्रवर्तन तथा सूचना प्रविधिको विस्तारलाई विशेष प्राथमिकता दिएका छन्। यी नीतिगत व्यवस्थालाई कार्यान्वयन गर्दै सार्वजनिक विद्यालयहरूमा गुणस्तरीय शिक्षाको पहुँच विस्तार गर्न तथा विद्यार्थीलाई सिपले सुसज्जित बनाउन गण्डकी प्रदेश सरकारले माध्यमिक तहका विद्यालयहरूमा STEM प्रयोगशाला स्थापना तथा सुदृढीकरणका लागि विद्यालयहरूलाई अनुदानको व्यवस्था गर्दै आएको छ।

विद्यालयमा स्थापना गरिने STEM प्रयोगशालाको भौतिक पूर्वाधार, आवश्यक उपकरण तथा सामग्री, सूचना तथा सञ्चार प्रविधि, सुरक्षा मापदण्ड, मर्मत सम्भार तथा प्रयोग प्रयोग सम्बन्धी न्यूनतम प्राविधिक मापदण्डमा एकरूपता कायम गर्न सामाजिक विकास मन्त्रालयबाट स्वीकृत *STEM Lab स्थापना तथा सञ्चालन सम्बन्धी गुरुर्योजना, २०७८* लाई परिमार्जन गरी यो “**STEM प्रयोगशाला स्थापना तथा सञ्चालन सम्बन्धी मार्गदर्शन, २०८३**” तयार गरिएको हो। यस मार्गदर्शनले प्रयोगशालाको स्थापना, सञ्चालन, व्यवस्थापन, सुरक्षा, उपकरणको प्रयोग, मर्मतसम्भार, शिक्षक क्षमता विकास, STEM क्लबको परिचालन तथा अनुगमन र मूल्याङ्कनका पक्षहरूलाई समेट्दै विद्यालयहरूलाई स्पष्ट दिशा प्रदान गरेको छ। यस मार्गदर्शनको प्रभावकारी कार्यान्वयनबाट विद्यालयको शिक्षण-सिकाई प्रक्रिया थप प्रयोगात्मक, अनुसन्धानमुखी, सृजनशील तथा परियोजनामूलक बन्ने, विद्यार्थीमा वैज्ञानिक दृष्टिकोण, नवप्रवर्तनमा उत्सुकता तथा सहकार्यत्मक सिकाई संस्कृतिको विकास हुने तथा सार्वजनिक विद्यालयप्रतिको विश्वास र आकर्षण अभिवृद्धि हुने अपेक्षा गरिएको छ। साथै, प्रदेशभर स्थापना हुने STEM प्रयोगशालामा गुणस्तर, पारदर्शिता, लागत प्रभावकारिता तथा दिगोपना सुनिश्चित गर्न पनि यस मार्गदर्शन उपयोगी हुने विश्वास लिइएको छ।

मार्गदर्शनको तयारीका लागि Center for Environmental and Sustainable Agricultural Research (CESAR) का अनुसन्धान निर्देशक डा. सन्तोष कोइराला, गण्डकी विश्वविद्यालयका असिस्टेन्ट प्रोफेसर ई. दिनेशमणि भट्टराई, ईन्द्रराज्यलक्ष्मी मावि, पोखरा मनपा-१६ का प्रधानाध्यापक केशवप्रसाद अम्गाई र गण्डकी

बोर्डिङ स्कूलका माध्यमिक तहका विज्ञान शिक्षक राजकुमार ढकालको महत्वपूर्ण योगदान रहेको छ। मार्गदर्शन तयारीका क्रममा सल्लाह तथा सुझाव प्रदान गर्नुहुने प्रधानाध्यापक, विषय शिक्षक, विद्यालय तथा अन्य सम्पूर्ण सरोकारवालाप्रति हार्दिक धन्यवाद व्यक्त गर्दछौं। यो मार्गदर्शनले गण्डकी प्रदेशमा STEM प्रभावकारी प्रभावकारी विस्तार, प्रयोगात्मक तथा नवप्रवर्तनमुखी शिक्षाको प्रवर्द्धनमा महत्त्वपूर्ण योगदान पुऱ्याउने विश्वासका साथ जारी गरिएको छ। मार्गदर्शनको कार्यान्वयन क्रममा प्राप्त हुने रचनात्मक सुझाव तथा पृष्ठपोषणलाई आगामी संस्करणमा समावेश गर्दै यसलाई अझ परिस्कृत र समय सापेक्ष बनाइनेछ।

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सामाजिक विकास, युवा तथा खेलकुद मन्त्रालय

गण्डकी प्रदेश, पोखरा

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१.१ परिचय

यस प्रदेशमा सञ्चालित शैक्षिक संस्थाहरूमा शैक्षिक पूर्वाधार विकास एवम् स्तरोन्नति, शिक्षा क्षेत्रमा कार्यरत जनशक्तिको क्षमता विकास तथा विद्यार्थी केन्द्रित शैक्षिक क्रियाकलाप सञ्चालन र सूचना प्रविधिको विस्तार कार्यमा योगदान पुऱ्याई सबैका लागि गुणस्तरीय शिक्षा सुनिश्चित गर्दै सार्वजनिक शिक्षालाई अभिभावक तथा विद्यार्थीको रोजाइको थलो बनाउने उद्देश्य प्राप्तिका लागि प्रभावकारी र व्यवस्थित रूपमा कार्यक्रम कार्यान्वयन गर्नु आवश्यक रहेको छ । राष्ट्रिय पाठ्यक्रम प्रारूप, २०७६ अनुसार विद्यालय शिक्षा समेत विज्ञान, प्रविधि, इन्जिनियरिङ तथा गणित (STEM) मा आधारित ज्ञान, सीप र नवप्रवर्तन क्षमताको विकासतर्फ उन्मुख हुँदै गएको छ । शिक्षालाई व्यवहारमुखी, अनुसन्धानमूलक, सिर्जनात्मक तथा समस्या-समाधानमा आधारित बनाउन विद्यालय तहदेखि नै STEM शिक्षाको प्रभावकारी कार्यान्वयन आवश्यक छ । राष्ट्रिय शिक्षा नीति, २०७६; गण्डकी प्रदेश शिक्षा नीति, २०७८; विद्यालय शिक्षा सुधारका कार्यक्रम तथा सूचना प्रविधिको बढ्दो प्रयोगलाई मध्यनजर गर्दै माध्यमिक तहका विद्यालयहरूमा STEM (Science, Technology, Engineering and Mathematics) Lab स्थापना र सुदृढीकरण गरी सञ्चालन गर्नु आवश्यक छ ।

STEM Lab ले विद्यार्थीलाई पाठ्यक्रममा आधारित सैद्धान्तिक ज्ञानलाई प्रयोगात्मक अभ्याससँग जोड्ने, परियोजनामूलक सिकाइ (Project-Based Learning), अनुसन्धान, नवप्रवर्तन तथा सहकार्यमा आधारित सिकाइका अवसर प्रदान गर्दछ । यसले विद्यार्थीमा वैज्ञानिक सोच, तार्किक विश्लेषण, डिजाइन सोच (Design Thinking), रोबोटिक्स, प्रोग्रामिङ तथा डिजिटल सीपको विकासमा महत्वपूर्ण योगदान पुऱ्याउँछ । यस उद्देश्य प्राप्तिका लागि विद्यालयमा स्थापना गरिने STEM Lab को भौतिक पूर्वाधार, आवश्यक उपकरण, फर्निचर, सूचना तथा सञ्चार प्रविधि, सुरक्षा मापदण्ड, सञ्चालन व्यवस्था, मर्मतसम्भार तथा प्रयोग सम्बन्धी प्राविधिक मापदण्ड स्पष्ट रूपमा निर्धारण गर्न आवश्यक भएकोले STEM Lab स्थापना तथा सञ्चालन सम्बन्धी गुरुयोजना, २०७८ लाई अद्यावधिक गरी यो विस्तृत मार्गदर्शन तयार गरिएको हो ।

१.२ उद्देश्य

माध्यमिक तहमा STEM Lab स्थापना तथा सञ्चालनका लागि यो मार्गदर्शन तयार गर्नुका मुख्य उद्देश्यहरू निम्नानुसार रहेका छन् :

- क. माध्यमिक तहका विद्यालयहरूमा स्थापना गरिने STEM Lab को न्यूनतम प्राविधिक, भौतिक तथा सञ्चालन ढाँचा निर्धारण गर्नु ।

- ख. प्रयोगशालाका लागि आवश्यक उपकरण, सामग्री, सफ्टवेयर, फर्निचर तथा सूचना-प्रविधि पूर्वाधारको स्पष्ट मार्गदर्शन तयार गर्नु ।
- ग. STEM शिक्षाको प्रभावकारी कार्यान्वयनका लागि प्रयोगशाला स्थापना, सञ्चालन, व्यवस्थापन तथा मर्मतसम्भार सम्बन्धी कार्यलाई व्यवस्थित गर्न सहयोग पुऱ्याउनु ।

१.३ प्रयोगशाला स्थापनाको महत्व र औचित्य

विद्यार्थीमा वैज्ञानिक सोच, नवप्रवर्तन, सिर्जनशीलता, समस्या-समाधान क्षमता, अनुसन्धान संस्कृति तथा समयानुकूल आवश्यक सीपहरूको विकासमा सहयोग पुऱ्याउने वातावरण सुनिश्चित गर्दै विद्यालयमा स्थापना हुने STEM Lab मा एकरूपता, गुणस्तरीयता, पारदर्शिता तथा लागत-प्रभावकारिता कायम गर्न आवश्यक आधार तयार गर्नु यस मार्गदर्शनको औचित्य हो । साथै, STEM Lab लाई विद्यालयको नियमित शिक्षण-सिकाइ प्रक्रियासँग एकीकृत गरी प्रयोगात्मक तथा परियोजनामूलक शिक्षालाई प्रवर्द्धन गर्नुपर्ने आवश्यकता रहेकोले, सार्वजनिक खरिद प्रक्रिया, उपकरण आपूर्ति तथा गुणस्तर सुनिश्चितताका लागि उपयोगी हुने गरी यो प्राविधिक मार्गदर्शन तयार गरिएको हो ।

१.४ अद्यावधिकका लागि लिइएका मुख्य आधार

- क. सामाजिक विकास मन्त्रालयबाट स्वीकृत STEM Lab स्थापना तथा सञ्चालन सम्बन्धी गुर्योजना, २०७८,
- ख. माध्यमिक तहको गणित र विज्ञान-प्रविधि विषयको पाठ्यक्रम,
- ग. प्रदेश सरकारको अनुदान सहयोगमा STEM Lab स्थापना भएका विद्यालयका गणित र विज्ञान-प्रविधि विषय अध्यापन गर्ने शिक्षकहरूबाट प्राप्त सुझावहरू ।

१.५ कार्यान्वयन विधि एवम् दिगोपनाको योजना

प्रयोगशालाको सञ्चालन, उपकरणको प्रयोग, सुरक्षा तथा मर्मतसम्भार सम्बन्धी कार्यविधि (Standard Operating Procedure – SOP) तयार गरी कार्यान्वयन गर्नुपर्नेछ । प्रयोगशालाको व्यवस्थापन, रेखदेख र नियमित सञ्चालनको जिम्मेवारी विद्यालय व्यवस्थापन समितिको समन्वयमा सम्बन्धित विषयगत शिक्षकहरूको हुनेछ । कुनै पनि किसिमको प्रयोगशाला नभएका विद्यालय र प्रयोगशाला सञ्चालनमा रहेका विद्यालयहरूले प्राथमिकताका आधारमा तपसिल बमोजिम स्थापना एवम् सञ्चालनको व्यवस्था मिलाउनुपर्नेछ ।

- क. सञ्चालनमा रहेका गणित/विज्ञान प्रयोगशालालाई एकीकृत प्रयोगशालाको रूपमा विकास गरी सञ्चालन गर्नुपर्नेछ ।
- ख. सम्बन्धित तहको पाठ्यक्रमले निर्धारण गरेका सिकाइ सक्षमता हासिल गर्नका लागि विषयगत शिक्षकहरूको संलग्नतामा आवश्यक सामग्री एवम् उपकरणहरू पहिचान गर्नुपर्नेछ ।

- ग. पहिलो चरणमा स्थानीय स्तरमा उपलब्ध हुने, कुनै आर्थिक स्रोत परिचालन गर्नु नपर्ने र कम मूल्यमा खरिद गर्न सकिने सामग्रीहरू पहिचान तथा व्यवस्थापन गर्नुपर्नेछ ।
- क. विषयगत शिक्षकको सहयोग एवम् विद्यार्थीको संलग्नतामा प्रयोगशाला सामग्रीहरू निर्माण तथा विकास गर्नुपर्नेछ ।
- ख. शिक्षकहरूको क्षमता विकास तथा पुर्नताजगी तालिम सम्बन्धित निकायले नियमित रूपमा आयोजना गर्नुपर्नेछ ।
- घ. अनुदान वा विद्यालयको स्रोतबाट सामग्री थप गर्नुपर्ने अवस्थामा उपलब्ध सामग्री र आवश्यकताको विश्लेषण गरी खरिद योजना तयार गर्ने, र खरिद योजना तयार गर्दा यस मार्गदर्शनमा उल्लेखित विषय क्षेत्रलाई आधार मानी खरिद गर्नुपर्नेछ ।
- ङ. प्रयोगशालाका उपकरण तथा सामग्रीको अभिलेख (Inventory Register), प्रयोग अभिलेख (Log Book), वर्कसिटको प्रयोग र मर्मतसम्भार तथा जिम्मेवारी अभिलेख नियमित रूपमा अद्यावधिक गर्नुपर्नेछ ।
- च. प्रयोगशालाको वार्षिक कार्ययोजना, समयतालिका तथा नियमित प्रयोगको योजना तयार गरी विद्यालयको शिक्षण-सिकाइ कार्यक्रमसँग एकीकृत रूपमा सञ्चालन गर्नुपर्नेछ ।
- छ. उपकरण तथा सफ्टवेयरको नियमित परीक्षण, अद्यावधिक (Update), मर्मतसम्भार तथा आवश्यक परे प्रतिस्थापनको व्यवस्था विद्यालयले सुनिश्चित गर्नुपर्नेछ ।
- ज. प्रयोगशालाको सरसफाइ, उपकरणको सुरक्षित भण्डारण, ऊर्जा तथा सामग्रीको मितव्ययी प्रयोग र वातावरणमैत्री व्यवस्थापनलाई प्राथमिकता दिनुपर्नेछ ।
- झ. विषयगत (गणित/विज्ञान/कम्प्युटर/इन्जिनियरिङ/ अन्य प्राविधिक विषय) शिक्षकको संयोजकत्वमा विद्यालयको आवश्यकता र विद्यार्थी सङ्ख्यालाई आधार मानी STEM क्लब गठन तथा परिचालन गर्नुपर्नेछ । यसरी क्लब गठन गर्दा प्राविधिक विषय सञ्चालन भएको विद्यालयले उक्त प्रकारका विद्यार्थीलाई समेत सहभागी गराउनुपर्नेछ ।
- ञ. इन्जिनियरिङ, रोबोटिक्स र विद्यार्थी-शिक्षकको उत्प्रेरणामा गरिने कामहरूका लागि नियमित समयतालिकाका अतिरिक्त थप समयमा समेत प्रयोगशाला प्रयोगको वातावरण सुनिश्चित गर्नुपर्नेछ ।
- ट. विद्यार्थीहरूलाई प्रयोगशाला प्रयोग गर्नुअघि अनिवार्य सुरक्षा अभिमुखीकरण (Safety Orientation) प्रदान गरिनुपर्नेछ ।
- ठ. अपाङ्गता भएका विद्यार्थीहरूको समान पहुँच सुनिश्चित गर्न भौतिक पूर्वाधार डिजाइनमा विशेष ध्यान दिनुपर्नेछ ।
- ड. नवप्रवर्तन (Innovation) का लागि थप आवश्यक पर्ने उपकरणहरू विद्यालयले आफ्नै स्रोतबाट (DIY अवधारणा अनुरूप) खरिद गर्नुपर्नेछ ।
- ढ. कार्ययोजना बमोजिम प्रयोगशाला सञ्चालन, प्रयोग र व्यवस्थापनसँग सम्बन्धित रही प्रतियोगिता सञ्चालन, प्रोत्साहन र पुरस्कारको व्यवस्थापन मिलाउनुपर्नेछ ।

१.६ STEM क्लब गठन तथा सञ्चालन

STEM क्लबको उद्देश्य, संरचना र सञ्चालन प्रक्रिया देहाय बमोजिम हुनेछ । विद्यालयले तोकिएको ढाँचामा क्लब गठन तथा परिचालन गर्ने गर्नुपर्नेछ ।

उद्देश्य:

- क. विद्यार्थीहरूमा विज्ञान तथा प्रविधिसम्बन्धी सिकाइको विकास गर्ने,
- ख. विद्यार्थीहरूमा विज्ञान तथा प्रविधिप्रतिको व्यक्तिगत अभिरुचिको विकास र प्रयोगका लागि वातावरण उपलब्ध गराउने,
- ग. विद्यार्थी-विद्यार्थीबीच पदक्रम-रहित भावनाले सिकाइ गर्ने संस्कारको विकास गर्ने,
- घ. आविष्कारमूलक सिकाइको प्रवर्द्धन गर्ने ।

संरचना:

- क. गणित, विज्ञान, कम्प्युटर विषयका शिक्षकहरूमध्येबाट एक जना शिक्षक संयोजक चयन गरी कम्तीमा ३ जना शिक्षक
- ख. कक्षा ६ देखि १२ सम्म अध्ययन गर्ने विद्यार्थीहरू मध्येबाट छात्र-छात्रा समान सहभागिता हुने गरी कम्तीमा ८ जना विद्यार्थी।

विद्यालयको आवश्यकता र विद्यार्थी सङ्ख्याका आधारमा सदस्य सङ्ख्या थपघट गर्न सकिनेछ ।

सञ्चालन तथा कार्यसम्पादन:

- क. प्रत्येक हप्ता कम्तीमा एक पटक छलफल गरी STEM सँग सम्बन्धित उपकरणको प्रयोग गरी विभिन्न परियोजनाको अन्वेषण गर्ने ।
- ख. महिनामा कम्तीमा एक पटक अन्य विद्यार्थीका लागि कार्यशाला सञ्चालन गर्ने ।
- ग. STEM सम्बन्धी प्रतियोगितामा सहभागिता जनाउने ।
- घ. एक शैक्षिक सत्रमा क्लब बाहिरका विद्यार्थीका लागि कम्तीमा ५ वटा STEM कार्यशाला आयोजना गर्ने ।

Chapter 2

Laboratory Structure and Materials Specification

2.1. The components of main structure of the laboratory:

2.1.1. Room Requirements

Size

The laboratory shall be designed to accommodate 24 students, excluding teachers, at a floor area of 43 square feet per student. The minimum standard floor area shall be 1,032 square feet.

Accessibility

At least one entrance shall be step-free, with a ramp of gradient not exceeding 1:12 where a level change exists. Door clear width shall not be less than 900 mm to permit wheelchair access, and at least one working table and sink shall be at a wheelchair-accessible height, in line with the National Building Code provisions for public buildings.

Doors

Each laboratory shall have a main entrance and an emergency exit. Doors shall be fitted with ventilation at the top, and the emergency exit shall not be less than 3 feet 6 inches in width.

Windows

The recommended area of window openings shall be one-fifth of the floor area to ensure adequate natural lighting and ventilation. Windows shall be provided on at least two sides of the room. The sill level shall be at least 2 feet 6 inches above the floor level, and the lintel level may extend up to the beam.

Electricity

Wiring shall be concealed within wall conduits and finished with plastering. Each laboratory or science classroom shall be fitted with a single emergency shut-off switch capable of breaking all circuits. The switch shall be clearly visible and readily accessible to the teacher, while remaining out of students' reach.

Plumbing

An open plumbing system shall be installed on the wall surface. CPVC pipes of half-inch diameter shall supply water to each sink, and a one-inch diameter pipe shall supply the showerhead. Separate gate valves shall be provided for the sinks and the showerhead.

Gas Supply

Gas lines shall branch from the main supply to each burner, with check valves installed to prevent reverse flow.

2.1.2. Interior Requirements

Furniture

Teacher's Area

A raised platform shall accommodate a teacher's desk and chair, with a writing board mounted on the wall behind it. The recommended dimension of the teacher's desk is 5' x 2'6" x 2'6".

Student Desks and Chairs

Desk: Custom-made wooden desks on wheels, metal-framed, with a waterproof, chemical-resistant phenolic resin laminate (Formica) top. Each desk shall accommodate no more than four students. Recommended specification — Table size: 6' x 3' x 2'6"; Edges: round; Surface finish: Formica laminate (1–1.3 mm thick).

Chair: Custom-made wooden chairs with a square seat, metal legs, and two footrest spindles at different heights. A center hole is recommended to allow the chair to be lifted safely, and sharp edges shall be avoided. Recommended specification — Seat size: 14" x 14"; Height: 2'.

Storage Cabinets

At least four storage cabinets shall be provided for Physics, Chemistry, Biology, and DIY materials. Recommended specification — Size: 5' x 1'6"; Height: full floor-to-ceiling height; Material: wood; Opening type: sliding or hinged with recessed handles; Shelf depth: not more than 12 inches. Biology storage cabinets may incorporate specimen display racks.

Display Cabinets

A display cabinet shall be provided for the demonstration of various items.

Exhibition/Writing Boards

Three to four movable boards shall be provided, usable either as exhibition boards or student writing boards.

Flooring

Cement concrete or polyvinyl flooring shall be used. Floor carpets shall be avoided.

Ceiling

For RCC structures, a painted cement concrete ceiling shall be used; for truss structures, a false ceiling of plywood or gypsum board shall be used.

Paints

Wipeable paints that resist liquid absorption and inhibit microbial growth are recommended, such as emulsion vinyl or acrylic paints.

Electricity Fixtures

At least six electrical outlets shall be mounted on the walls, positioned near the students' working tables.

Sanitary Fixtures

Single-bowl sinks made of ceramic, steel, or polypropylene are recommended. At least six sinks shall be provided for students, with an additional sink for teachers, positioned near the working desks.

Burners

At least six Bunsen burners shall be provided, positioned near each student's working table, with LPG used as the gas supply.

Fume Hoods

Chemicals with significant inhalation hazards shall be opened only inside fume hoods, and experiments generating corrosive or toxic gases shall be performed only inside fume hoods. A chemical fume hood with a ducted outlet or exhaust fan shall be used, fitted with internal lighting. A fume hood with storage cabinets is recommended.

Preparation Platform

Preparation areas shall provide sufficient space for practical equipment. Recommended specification — Top width: 2'; Surface finish: rough ceramic tiles (50–70 mm thick); Height: 2'7". Storage cabinets may be provided below the work surface for chemicals and equipment.

2.1.3. Safety Requirements**Fire Safety**

At least two fire extinguishers shall be placed at separate locations inside the laboratory; powder-type ABC extinguishers are recommended. Woolen blankets shall be stored for use in protecting persons during a fire and as fire inhibitors, and sand shall be stored in buckets for metal fires.

First Aid

Each laboratory shall have a first aid kit containing essential medicines, antiseptic lotions, creams, bandages, sterilized cotton, Dettol, and similar items.

Shower and Eye Wash

Each laboratory shall have a safety shower and eyewash station to protect persons from chemical splashes, burns, and eye exposure to hazardous substances. These shall be located within 25 feet of each working area and shall provide a continuous water supply for at least fifteen minutes once activated.

Chemical Storage and Labeling

All chemicals shall be stored in a dedicated, lockable, ventilated storage cabinet, segregated by hazard class (acids, bases, oxidizers, flammables) rather than alphabetically, with incompatible chemicals physically separated. Every container shall carry a legible label showing the chemical name, hazard symbol, and date of receipt. A Material Safety Data Sheet (MSDS) shall be kept on file for each hazardous chemical held in the laboratory and shall be readily accessible to the subject teacher. Concentrated acids and oxidizing agents (e.g., concentrated HCl, H₂SO₄, KMnO₄) shall be stored at or below eye level, never on high shelves.

Waste Boxes

Different categories of waste shall be collected in separate, clearly labelled boxes, including a designated container for chemical waste requiring neutralization or licensed disposal rather than disposal in general waste.

2.1.4. Lab Uniform and Safety Wear

Uniform

Every student shall wear an apron before entering the laboratory. Coats and jackets may be hung on apron hangers placed near the entrance.

Safety Wear

While handling hazardous substances, all persons shall wear appropriate masks, safety glasses, gloves, helmets, and other personal protective equipment (PPE) as required.

Chapter 3

Monitoring, Evaluation and Sustainability

This chapter defines how STEM Lab usage is recorded, how lab condition and performance are periodically assessed, and how ongoing maintenance responsibility is assigned — giving practical effect to the monitoring obligations set out in Section 1.5.

3.1. Daily Use Logbook

Each STEM Lab shall maintain a daily logbook recording every session of use. A common cover format is given below; laboratory-specific logbook formats — tailored to Physics, Chemistry, Biology, Mathematics, and Robotics/DIY use respectively — are provided in Annex II and shall be used in place of a single generic log wherever a school operates discipline-specific lab space.

Date	Entry Time	Class / Teacher	Activity	Equipment Used	Exit Time	Remarks

A digital copy of each month's entries shall be compiled and uploaded to the school's webpage or submitted to the concerned education office.

3.2. Periodic Inspection and Evaluation

The STEM Lab coordinator, in coordination with the school management committee, shall conduct a documented inspection at least once per term using the checklist below, and shall retain completed inspection reports for at least three years.

Inspection Item	Finding
School name / address	
STEM Lab coordinator	
Date and time of visit	
Lab open / closed at time of visit	
Cleanliness and equipment order (labelled storage)	
Logbook maintained up to date (Y/N, last entry date)	
Inventory register reconciled against physical stock (% match)	
STEM Club membership roster current (Y/N)	
Active project(s) or innovation in progress	

Inspection Item	Finding
Safety equipment present and in-date (extinguishers, first aid, eyewash)	
Any damaged wiring, fixtures, or hazards noted	
Corrective actions required	

3.3. Maintenance and Sustainability Responsibility

- The school shall bear routine operating costs (cleaning, consumables, minor repairs) from its own budget; the Ministry/local government grant covers initial establishment and periodic major equipment replacement only.
- Equipment requiring calibration or servicing (balances, oscilloscopes, microscopes) shall be serviced at least annually, with service records kept alongside the inventory register.
- Teacher capacity-development and refresher training shall be organized at least once a year by the concerned authority (see Section 1.7, Recommendation).
- Electronic and chemical waste shall be disposed of through a licensed waste handler, not general municipal waste, and disposal records retained for audit.

Annexs

Annex I

Materials and Equipment Specification

Materials required for conducting curriculum-based science practicals and STEM activities are categorized by science discipline. The following tables specify the recommended items for each laboratory section.

Materials and Equipment for Physics Laboratory

S.N.	Item	Description
1	Aluminum foil	Pure aluminum foil, 0.02 mm thickness, supplied in roll form
2	Aluminum wire	Pure aluminum wire, 0.3 mm diameter, bare, supplied in 50 m roll
3	Ammeter	Moving coil type, range 0–1 A, accuracy $\pm 1\%$, with clear scale and safety terminals, suitable for school physics experiments
4	Astronomical Kits (Solar filter, Sundial, Planisphere, Solar eclipse spectacles)	Standard
5	Astronomical Telescope	Refracting type, objective aperture 60 mm, focal length 700 mm, eyepieces of 10 mm and 20 mm, magnification up to 70 $\times$, supplied with tripod and accessories
6	Bar magnets	Alnico permanent magnet, size 75 mm $\times$ 12 mm $\times$ 8 mm, with clearly marked N and S poles, supplied with magnetic keeper
7	Bathroom scale (Digital)	Capacity 150 kg, least count 0.1 kg, with LCD display and durable platform
8	Bottle opener	Standard
9	Aluminum plate	Pure aluminum plate, 100 mm $\times$ 100 mm $\times$ 2 mm thickness, smooth surface
10	Bunsen Burner	Brass/stainless steel laboratory burner, 150 mm height, with adjustable air and gas control
11	Calorimeter set	Copper calorimeter of 500 ml capacity with double-holed insulating lid, copper stirrer, and outer jacket

S.N.	Item	Description
12	Carbon rods	Graphite rod, 6 mm diameter $\times$ 100 mm length, high purity, suitable for electrical and electrochemical experiments.
13	Clinical thermometer	Digital & Analog
14	Colored glass sheet	Small sheets of different colors
15	Compass (Magnetic)	50 mm diameter, with magnetic needle, 360° graduated dial, transparent cover
16	Concave lens	Optical glass, double concave type, 50 mm diameter, focal length about -15 cm
17	Concave mirrors	Spherical glass mirror, 50 mm diameter, focal length 15 cm
18	Conducting wires	Different color codes
19	Convex lens	Optical glass, double convex type, 50 mm diameter, focal length 15 cm
20	Convex mirror	Spherical glass mirror, 50 mm diameter, focal length 15 cm
21	Copper plate	Standard for copper plating
22	Copper wire	PVC insulated copper wire, 0.5 mm diameter, flexible
23	Copper wire (Solenoid)	Enameled copper wire, 0.5 mm diameter
24	Cork borer	Brass/stainless steel, set of 6 pieces (5–15 mm diameter)
25	Corks (Rubber & wooden)	Different size
26	Crocodile clips	Nickel-plated brass, spring-loaded, 50 mm length, PVC insulated cover, suitable for electrical circuit connections
27	Digital balance (Chemical balance)	Capacity 500 g, least count 0.01 g, accuracy ± 0.01 g, stainless steel pan
28	Disposable syringe	10 ml/20 ml (Plastics)
29	Droppers	10 ml/20 ml (Plastics)
30	Dry cell	1.5 V
31	Dynamo (Working model)	Standard (For demonstration)
32	Ebonite rods	Hard rubber rod, 250 mm length $\times$ 12 mm diameter, polished surface, suitable for electrostatics experiments.
33	Eureka can	Metal/stainless steel, 500 ml capacity, with side overflow spout
34	Forceps	Standard
35	Galvanometer	Centre-zero type, sensitivity 1 mA/division, resistance about 50 Ω , with clear scale and terminals
36	Generator(Working model)	Standard (For demonstration)
37	Glass cutter	Standard

S.N.	Item	Description
38	Glass rod	Standard
39	Glass slab	Rectangular optical glass slab, 100 mm × 60 mm × 15 mm, with plain and polished surfaces
40	Glass tubes	Standard
41	Hand lens	Convex glass lens, 75 mm diameter, 3× magnification, with durable plastic/metal handle
42	Hygrometer	Relative humidity meter, range 0–100% RH, accuracy ±3% RH, with thermometer facility
43	Iron ball with ring	Metal ball of 25 mm diameter with matching metal ring, mounted on a handle, suitable for demonstrating thermal expansion of solids
44	Iron dust	Lab Grade
45	Iron fillings	Lab Grade
46	Iron rod or Iron nail	Standard for lab use/ 4 inch
47	Lab thermometer	Alcohol & Mercury of various calibration
48	Lever bar and stand	Metal lever bar of 600 mm length with knife-edge fulcrum, adjustable stand, weight hanger
49	Magnets of various type	Cylindrical, U shape, Horseshoe shape, etc.
50	Maximum- Minimum Thermometer	Range –10°C to 110°C, least count 1°C, with U-shaped glass tube, maximum and minimum indicators, mounted on a suitable frame
51	Measuring Cylinders (Various)	Graduation (least count): • 100 ml cylinder: 1 ml • 250 ml cylinder: 2 ml • 500 ml cylinder: 5 ml
52	Mercury Barometer	Laboratory type, 0–800 mm Hg range, 1 mm Hg least count, glass tube mounted on a graduated wooden frame with mercury reservoir, suitable for atmospheric pressure measurement
53	Plain mirror	75 mm × 50 mm × 3 mm, optical-quality, mounted or unmounted with polished edges.
54	Power pack (Voltage controller)	Regulated variable DC output 0–12 V, 0–5 A, with digital voltage and current display, overload and short-circuit protection
55	Prism	Equilateral glass prism, Refracting angle: 60°, Triangular face: 25 mm × 25 mm × 25 mm, length: 50 mm, Optical-quality crown glass with polished faces
56	Pulleys	Single fixed, single movable, combined, etc.

S.N.	Item	Description
57	Rain gauze	Standard meteorological rain gauge with transparent collecting bottle, funnel, graduated cylinder, measuring range 0–100 mm, least count 1 mm
58	Ray box	LED light source, 6–12 V DC, interchangeable slit plates (single, double, triple and five-ray), built-in collimating lens, approximately $180 \times 90 \times 70$ mm, suitable for reflection, refraction, lens and prism experiments.
59	Retort stand	Heavy cast iron base, stainless steel rod, 600 mm height $\times$ 12 mm diameter rod, supplied with boss head and clamp,
60	Rubber pad	Soft rubber, 50 mm diameter & 10 mm thick
61	Screw driver	Standard
62	Screw gauze	Range 0–25 mm, least count 0.01 mm, pitch 0.5 mm, with ratchet stop and lock nut.
63	Screw nail	Mild steel, 3 mm diameter $\times$ 25 mm length is a suitable standard size.
64	Simple pendulum	Brass spherical bob of 25 mm diameter, mass about 50 g, attached with non-stretchable thread of adjustable length up to 1 m
65	Slotted mass	Brass/cast iron, set containing $10 \text{ g} \times 2$, $20 \text{ g} \times 2$, $50 \text{ g} \times 2$, $100 \text{ g} \times 2$ masses with 50 g g hanger
66	Soft wooden board	Suitable for A4 size paper
67	Spirit Lamp	Standard
68	Stand and clamp	Heavy cast iron base with $600 \text{ mm} \times 12 \text{ mm}$ stainless steel rod, supplied with adjustable boss head and universal clamp
69	Stopwatch	Accuracy 0.01 s, with start/stop/reset and lap facility
70	Tin can (Enamel coated)	Cylindrical tin can, 500 ml capacity, enamel coated inside and outside, with handle, suitable for heat and calorimetry experiments
71	Tongs	Standard
72	Triple Beam balance	Standard
73	Tuning forks	Made of steel, frequencies 256 Hz, 320 Hz, 384 Hz and 512 Hz, with handles and rubber striker
74	Vernier calipers	Stainless steel, metric type, range 0–150 mm, least count 0.02 mm, with inside, outside and depth measuring facilities
75	Voltmeter	Moving coil type, range 0–15 V, accuracy $\pm 1\%$, clear scale with red and black terminals, suitable for measuring potential difference in electrical circuits.

S.N.	Item	Description
76	Pan balance	Two-pan beam balance, capacity 500 g, least count 10 mg, with stainless steel pans and complete set of standard weights
77	Wooden splinter	Dry soft wood splinter, approximately 75 mm length $\times$ 3 mm diameter
78	Zinc plate	Pure zinc metal plate, 50 mm $\times$ 50 mm $\times$ 1 mm thickness (or appropriate size)

Materials and Equipment for Chemistry Laboratory

S.N.	Item	Description
1	Asbestos sheet	Heat-resistant laboratory grade
2	Beakers	Borosilicate, 25–500 mL
3	Beehive shelf	Porcelain laboratory grade
4	Bloating paper	High absorbency laboratory grade
5	Bunsen burner	LPG compatible
6	Burette	Borosilicate, 50–100 mL, stopcock
7	China dish / porcelain basin	Glazed porcelain, heat-resistant
8	Chromatography paper	Whatman equivalent, laboratory grade
9	Chromatography spinner	Motorized
10	Condenser	Borosilicate Liebig type
11	Conical flask	Borosilicate, narrow neck
12	Copper plate	Pure copper sheet
13	Cork borer	Set of assorted sizes
14	Corks	Rubber and cork assortment
15	Delivery tube	Borosilicate glass
16	Digital balance	Max weighs 500 g, accuracy 0.1 g
17	Droppers	Plastic, graduated
18	Filter paper	Medium grade
19	Flat bottom flask	Borosilicate laboratory grade
20	Funnel	Borosilicate glass, standard
21	Funnel stand	Corrosion-resistant metal
22	Gas jar	Borosilicate, ground rim
23	Gas jar lid	Ground glass plate
24	Glass cutter	Tungsten carbide wheel
25	Glass rod	Polished borosilicate glass
26	Glass tube	Borosilicate tubing
27	Iron stand	Cast iron base
28	Measuring cylinders	Borosilicate, 10–1000 mL
29	Pipette	Borosilicate, graduated
30	Reagent bottle	Borosilicate, clear
31	Round bottom flask	Borosilicate laboratory grade

S.N.	Item	Description
32	Spatula	Stainless steel
33	Spirit lamp	Brass
34	Stand and clamp	Adjustable laboratory stand
35	Straw pipe	Flexible plastic tubing
36	Test tube holder	Wooden spring type / stainless steel
37	Test tubes	Borosilicate, 5–50 mL
38	Thistle funnel	Borosilicate glass
39	Tongs	Stainless steel
40	Tripod stand	Heavy-duty iron
41	Voltmeter	Hofmann electrolysis type
42	Volumetric flask	Borosilicate, 25–500 mL
43	Watch glass	Borosilicate glass
44	Water trough	Plastic laboratory grade
45	Wax	Paraffin laboratory grade
46	Wire gauze	Ceramic center mesh
47	Woulfe's bottle	Three-neck borosilicate
48	Zinc plate	Pure zinc sheet
49	Test tube stand	Wooden or plastic
50	Periodic table chart	Laminated, large format

Materials and Equipment for Biology Laboratory

S.N.	Item	Description
1	Brushes	Soft bristle laboratory
2	Compound microscope	40–1000X magnification
3	Cover slip	Glass, 18×18 to 24×24 mm
4	Dissecting box	Complete stainless-steel set
5	Dissecting tray	Wax-lined, stainless steel
6	Forceps	Stainless steel, fine tip
7	Glass dropper	Borosilicate with rubber bulb
8	Glass slide	Pre-cleaned microscope slides
9	Laminated charts of biological materials	Full-color laminated charts
10	Museum specimens of invertebrates and vertebrates	Preserved, labeled specimens
11	Permanent slides of micro-organisms	Prepared microscope slide set
12	Permanent slides of cell division stages	Prepared microscope slide set
13	Permanent slides of tissues	Prepared microscope slide set
14	Plastic models of human organs / organ systems	Detachable anatomical models
15	Projection microscope	40–1000X magnification; HDMI/digital output to projector or screen
16	Scissors	Stainless steel laboratory
17	Watch glass	Borosilicate glass

18	Wax	Paraffin laboratory grade
19	Petri dish	Glass or autoclavable plastic

Chemicals Required for the Science Laboratory

S.N.	Item	Description
1	Methanol	Lab grade
2	Aluminum foil	Lab grade
3	Aluminum piece	Lab grade
4	Manganese dioxide	Lab grade
5	Ammonia solution	Lab grade
6	Ammonium chloride	Lab grade
7	Carbon powder	Lab grade
8	Calcium oxide	Lab grade
9	Calcium bicarbonate	Lab grade
10	Calcium hydroxide	Lab grade
11	Camphor	Lab grade
12	Potassium hydroxide	Lab grade
13	Hydrochloric acid	Lab grade
14	Sulphuric acid	Lab grade
15	Ethanol	Lab grade
16	Safranin	Lab grade
17	Glycerin	Lab grade
18	Leishman's stain	Lab grade
19	Magnesium ribbon	Lab grade
20	Zinc powder	Lab grade
21	Zinc pieces	Lab grade
22	Hydrogen peroxide	Lab grade
23	Potassium dichromate	Lab grade
24	Iodine solution	Lab grade
25	Silver nitrate	Lab grade
26	Phenolphthalein	Lab grade
27	Methyl orange	Lab grade
28	Limestone (calcium carbonate)	Lab grade
29	Litmus solution	Lab grade
30	Litmus paper	Lab grade
31	Magnesium bicarbonate	Lab grade
32	Copper sulphate	Lab grade
33	Potassium permanganate	Lab grade

S.N.	Item	Description
34	Sodium chloride	Lab grade
35	Sodium hydroxide	Lab grade
36	Sodium nitrite	Lab grade
37	Spirit	Lab grade
38	Diethyl ether	Lab grade

Materials and Equipment for Mathematics

Number Sense

S.N.	Item	Description
1	Place Value Kit	Plastic/wooden place value blocks with ones, tens, hundreds, thousands; reusable storage box
2	Fraction Circles	Durable plastic, color-coded, complete fraction set (1 to 1/12 or better)
3	Fraction Strips	Laminated/plastic color-coded fraction strips with storage tray
4	Decimal Squares	Transparent/plastic decimal grids (10×10), classroom quality
5	Decimal Cubes	Base-10 decimal cube model set, durable plastic
6	Percentage Discs	Color-coded percentage circles (1–100%), plastic
7	Integer Tiles	Double-sided positive/negative tiles, magnetic preferred
8	Algebra Tiles	Color-coded plastic algebra tiles for classroom use
9	Base Ten Blocks	Plastic demonstration set including unit, rod, flat, cube
10	Number Line Set	Floor and desk number lines, laminated, -20 to +20 or wider
11	Counting Cubes	Interlocking plastic cubes, assorted colors
12	Linking Cubes	Snap-fit connecting cubes, minimum 100 pieces
13	Balance Scale	Two-pan balance with weights, classroom demonstration model

Geometry

S.N.	Item	Description
1	Large Geometry Set	Teacher demonstration geometry set (compass, ruler, protractor, set squares)
2	Student Geometry Sets	Standard geometry box with compass, divider, ruler, protractor, set squares
3	Geoboards	Plastic geoboards (11×11 peg or equivalent) with rubber bands
4	Elastic Bands	Assorted colored rubber bands suitable for geoboards
5	Pattern Blocks	Plastic geometric pattern block set with storage case
6	Tangram Sets	Seven-piece colored plastic/wooden tangram set
7	Pentomino Sets	Durable plastic pentomino puzzle pieces
8	Polyhedron Models	Transparent or colored 3D polyhedral set
9	Transparent Geometry Solids	Hollow transparent solids with removable lids for volume demonstration
10	Nets of Solids	Laminated foldable nets of common 3D solids
11	Angle Demonstrator	Rotating plastic angle model (0°–360°)
12	Circle Fraction Kit	Magnetic/plastic circle fraction demonstration set
13	Symmetry Mirror	Acrylic mirror for symmetry activities
14	Reflection Mirror	Double mirror hinged for reflection investigation

S.N.	Item	Description
15	Coordinate Grid Board	Magnetic or whiteboard grid with X–Y coordinates

Measurement

S.N.	Item	Description
1	Digital Weighing Scale	Capacity 5–10 kg, LCD display, accuracy ± 1 g
2	Spring Balance	1–5 kg range with clear graduation
3	Measuring Cylinders	Plastic set (50 ml, 100 ml, 250 ml, 500 ml)
4	Meter Sticks	Wooden/aluminum, 1 m length, metric graduation
5	Measuring Wheels	Measuring wheel with digital/mechanical counter
6	Trundle Wheel	Heavy-duty survey wheel, foldable preferred
7	Digital Stopwatch	LCD display, 1/100 sec accuracy
8	Vernier Caliper	Stainless steel, 150 mm, least count 0.02 mm
9	Micrometer Screw Gauge	Range 0–25 mm, least count 0.01 mm
10	Clinometer	Handheld inclinometer, $\pm 90^\circ$ measurement
11	Compass	Magnetic field compass with clear degree markings
12	Digital Thermometer	LCD display, -50°C to $+300^\circ\text{C}$ or equivalent

Algebra

S.N.	Item	Description
1	Algebra Balance	Physical algebra balance model with weights
2	Function Machine	Demonstration model for input-output functions
3	Equation Board	Magnetic/whiteboard equation solving board
4	Variable Cubes	Color-coded algebra variable cubes

Statistics

S.N.	Item	Description
1	Probability Spinner	Adjustable spinner with multiple sectors
2	Dice Set	Standard six-sided and polyhedral dice set
3	Large Dice	Foam/plastic large demonstration dice
4	Colored Counters	Plastic counters in multiple colors (100+ pieces)
5	Graph Board	Reusable graph plotting board, magnetic preferred
6	Bar Graph Kit	Manipulative graph kit with bars and labels
7	Coordinate Peg Board	Pegboard with coordinate grid and pegs

Mathematical Thinking

S.N.	Item	Description
1	Rubik's Cube	Standard 3×3 speed cube
2	Soma Cube	Seven-piece wooden/plastic puzzle

S.N.	Item	Description
3	IQ Puzzle Sets	Assorted logic puzzle collection
4	Logic Puzzle Set	Educational logical reasoning puzzle kit
5	Sudoku Board	Reusable Sudoku board with number tiles
6	Mathematical Card Games	Mathematics learning card games for arithmetic/algebra
7	Chess Sets	Tournament-size plastic/wooden chess set
8	Tower of Hanoi	Wooden/plastic tower puzzle
9	Brain Teaser Kits	Collection of mechanical brain puzzles

STEM Mathematics Integration

S.N.	Item	Description
1	Fibonacci Spiral Kit	Demonstration model showing Fibonacci sequence and spiral
2	Golden Ratio Models	Demonstration kit illustrating the golden ratio
3	Pascal Triangle Board	Magnetic or laminated Pascal triangle board
4	Fractal Models	Educational fractal demonstration models
5	Mathematical Art Kit	Geometry and symmetry art activity kit
6	Tessellation Kit	Polygon tessellation manipulatives

Digital Mathematics

S.N.	Item	Description
1	Scientific Calculators	Non-programmable scientific calculator, 240+ functions
2	Graphing Calculators	Graphing calculator with large display and graph plotting
3	GeoGebra Software	Latest licensed/free educational version, Windows compatible
4	Spreadsheet Software	Microsoft Excel or equivalent educational spreadsheet software
5	Coding for Mathematics	Educational software such as LaTeX, Mathematica, MATLAB, or equivalent

Materials and Equipment for STEM Robotics Laboratory

The robotics section has been updated to reflect current classroom practice, including modern development platforms, an expanded sensor and communication-module collection, additional display and actuator options, and strengthened safety provisions. Equipment is organized into the following categories: DIY Fabrication, Electronics Workstation, Robotics & Embedded Systems, Mechanical Hand Tools, and Measurement & Assembly.

DIY Fabrication Station

S.N.	Item	Description
1	3D Printer	FDM, build volume $\geq 220 \times 220 \times 250$ mm, auto bed levelling preferred
2	PLA Filament	1.75 mm, multiple colors, 1 kg spool
3	Desktop Computer	Intel Core i5/Ryzen 5, 16 GB RAM, SSD, CAD compatible
4	Cordless Drill	12–18V rechargeable
5	Hand Drill	Manual precision drill
6	Circular Saw	1200–1500 W
7	Jigsaw	Variable speed
8	Electric Planer	600–800 W
9	Angle Grinder	100 mm, 850 W
10	Grinding Disc	Metal cutting type
11	Grinding Wheel	General grinding type
12	Planer Blades	Replacement set
13	Heat Blower	Adjustable temperature
14	Arc Welding Machine	Inverter type, 200 A
15	Welding Rods	General purpose electrodes
16	Drill Bit Set	Metal, wood and masonry
17	Safety Goggles	Industrial grade
18	Protective Gloves	Heat resistant
19	Face Shield	Grinding and welding safety
20	Dust Mask	Reusable safety mask

Electronics Workstation

S.N.	Item	Description
1	Variable DC Power Supply	0–30V, 0–5A bench supply
2	Component Storage Cabinet	Multi-drawer
3	Extension Board	Surge protected
4	Soldering Station	Temperature controlled (60–90W)

S.N.	Item	Description
5	Soldering Iron	60W
6	Lead-free Solder Wire	Electronics grade
7	Solder Flux	Electronics grade
8	Solder Paste	Electronics grade
9	Desoldering Pump	High suction
10	Helping Hand with Magnifier	PCB holder
11	Digital Multimeter	Auto-ranging
12	Digital Oscilloscope	50 MHz or higher
13	Glue Gun	40W
14	Glue Sticks	11 mm
15	ESD Tweezers Set	Anti-static
16	LED Table Lamp	Adjustable
17	PCB Cleaning Brush	Anti-static
18	Wire Ferrule Kit	Assorted sizes
19	Heat Shrink Tube Kit	Assorted sizes

Robotics & Embedded Systems Station

Microcontrollers

S.N.	Item	Description
1	Arduino Uno R3	ATmega328P compatible
2	Arduino Nano	USB Type-C or Micro USB
3	ESP32 Development Board	Wi-Fi + Bluetooth dual core

Prototyping

S.N.	Item	Description
1	Breadboard	830 tie points
2	Mini Breadboard	400 tie points
3	Jumper Wire Kit	Male–Male, Male–Female, Female–Female
4	Prototype PCB Board	Universal
5	Prefab board	General purpose

Display Modules

S.N.	Item	Description
1	I2C LCD Display	16×2-character LCD
2	OLED Display	0.96" I2C, 128×64
3	7-Segment Display	Single and four-digit

Sensor Modules

S.N.	Item	Description
1	Ultrasonic Sensor	HC-SR04
2	Infrared Obstacle Sensor	IR reflective
3	Line Tracking Sensor	IR array
4	DHT11 Sensor	Temperature and humidity
5	DHT22 Sensor	High-accuracy temperature and humidity
6	Gas Sensor	MQ-2 smoke/LPG
7	Soil Moisture Sensor	Capacitive type
8	Rain Sensor	Analog/digital
9	Flame Sensor	Infrared flame detection
10	Light Sensor	LDR module
11	Sound Sensor	Microphone module
12	Touch Sensor	Capacitive
13	PIR Motion Sensor	HC-SR501
14	Hall Effect Sensor	Magnetic field detection
15	Tilt Sensor	Ball switch
16	Water Level Sensor	Analog
17	Color Sensor	TCS3200
18	Gesture Sensor	APDS9960
19	Accelerometer & Gyroscope	MPU6050
20	Compass Sensor	HMC5883L
21	RFID Reader	RC522
22	GPS Module	NEO-6M

Communication Modules

S.N.	Item	Description
1	Bluetooth Module	HC-05 / HC-06
2	Wi-Fi Module	ESP8266
3	NRF24L01 Module	2.4 GHz wireless
4	LoRa Module	SX1278 long-range communication

Actuators

S.N.	Item	Description
1	Micro Servo Motor	SG90
2	High Torque Servo	MG996R

S.N.	Item	Description
3	DC Geared Motor	6–12V
4	Stepper Motor	28BYJ-48
5	Stepper Motor Driver	ULN2003
6	Motor Driver	L293D
7	Motor Driver	L298N
8	Motor Driver	TB6612FNG
9	Relay Module	1-channel / 4-channel

Robot Kits

S.N.	Item	Description
1	2WD Robot Chassis Kit	Acrylic or metal
2	4WD Robot Chassis Kit	Metal frame
3	Meconium Robot Kit	Omnidirectional
4	Robot Wheels	Rubber
5	Caster Wheel	Universal

Power Components

S.N.	Item	Description
1	18650 Rechargeable Battery	Lithium-ion
2	18650 Battery Holder	Single/dual cell
3	9V Battery	Alkaline
4	AA Battery Holder	2-cell/4-cell
5	18650 Battery Charger	Smart charger
6	USB Power Module	5V regulated output

Electronic Components

S.N.	Item	Description
1	LED Kit	Assorted colors
2	Resistor Kit	220 Ω –1M Ω
3	Capacitor Kit	Ceramic & electrolytic
4	Transistor Kit	NPN & PNP
5	MOSFET Kit	Logic level
6	Diode Kit	General purpose
7	Push Button Kit	Momentary switches
8	Potentiometer	10K Ω
9	Piezo Buzzer	Active & passive

S.N.	Item	Description
10	Crystal Oscillator Kit	Various frequencies

Mechanical Hand Tools

S.N.	Item	Description
1	Adjustable Wrench	8-inch
2	Allen Key Set	Metric
3	Combination Pliers	Insulated
4	Long Nose Pliers	Insulated
5	Diagonal Cutter	Precision
6	Wire Stripper	Automatic
7	Wire Cutter	Precision
8	Screwdriver Set	Insulated
9	Precision Screwdriver Set	Electronics
10	Ball Peen Hammer	Standard
11	Claw Hammer	Standard
12	Rubber Mallet	Medium
13	Hacksaw	Metal cutting
14	Mini Hacksaw	Precision
15	Metal File Set	Flat, round & half-round
16	Tin Snips	Metal sheet cutting
17	Spanner Set	Metric
18	Tap & Die Set	Metric
19	Nuts, Bolts & Washers	Assorted
20	Cable Ties	Various sizes

Measurement & Assembly Station

S.N.	Item	Description
1	Bench Vice	6-inch
2	Digital Vernier Caliper	0–150 mm
3	Steel Ruler	300 mm
4	Measuring Tape	5 m
5	Carpenter Square	90°
6	Spirit Level	600 mm
7	G-Clamp	2", 4", 6"
8	Spring Clamp	Medium
9	Rivet Gun	Hand-operated

S.N.	Item	Description
10	Blind Rivets	Assorted sizes
11	Metal Protractor	180°

Common Items Required Across Multiple Laboratories

The item lists in each section were reviewed to identify equipment that recurs under the same or a closely equivalent name across more than one laboratory section. Grouping these items allows a school to consolidate procurement, share a single unit across labs where appropriate, and avoid duplicate purchase. This section is additional to, and does not replace, the discipline-wise lists above.

Common Item	Laboratories Using It	Consolidation Note
Measuring Cylinders	Physics, Chemistry, Mathematics	Same core item (graduated cylinders); Physics/Chemistry specify borosilicate glass, Mathematics a plastic classroom set. Procure a shared borosilicate set for science labs plus a small plastic set for math manipulatives.
Digital Balance	Physics, Chemistry, Mathematics (Digital Weighing Scale)	Physics/Chemistry both specify a 500 g capacity chemical balance; one shared, calibrated balance can serve both labs. Mathematics' 5–10 kg scale serves a different range and may remain separate.
Vernier Caliper	Physics, Mathematics, Robotics (Digital Vernier Caliper)	One stainless-steel/digital vernier caliper set (0–150 mm) can be shared across Physics, Mathematics measurement, and the Robotics assembly station.
Bunsen Burner	Physics, Chemistry	Identical item; a shared bank of burners near student tables serves both subjects, per the six-burner minimum in Chapter 2.
Compass (Magnetic)	Physics, Mathematics	Same magnetic field compass; can be shared between Physics (magnetism experiments) and Mathematics (direction/measurement activities).
Screwdriver / Screw Gauge	Physics (Screw driver, Screw gauge), Mathematics (Micrometer Screw Gauge), Robotics (Screwdriver Set,	Physics' screw gauge is functionally the same instrument as Mathematics' micrometer screw gauge; screwdrivers listed for Physics and the Robotics hand-tool set can be pooled in one tool cabinet.

Common Item	Laboratories Using It	Consolidation Note
	Precision Screwdriver Set)	
Stopwatch	Physics (Stopwatch), Mathematics (Digital Stopwatch)	Same instrument; one digital stopwatch set (0.01 s accuracy) can serve timing needs in both labs.
Corks / Cork Borer	Physics, Chemistry	Identical consumables and tool; procure jointly and store in the shared DIY/consumables cabinet.
Droppers / Glass Dropper	Physics, Chemistry, Biology	Same function (liquid transfer); Physics/Chemistry specify plastic graduated droppers, Biology a borosilicate dropper with rubber bulb — both can be sourced from one supplier order.
Copper Plate	Physics, Chemistry	Same item, used for electroplating/electrochemistry demonstrations in both labs.
Zinc Plate	Physics, Chemistry	Same item, used in electrochemical cell and reactivity experiments.
Glass Rod	Physics, Chemistry	Identical item; a shared stock in the science storage cabinet avoids duplicate ordering.
Glass Tube(s)	Physics, Chemistry	Same consumable glassware; order as a common batch.
Glass Cutter	Physics, Chemistry	Same tool; one glass cutter can be shared between the two labs.
Spirit Lamp	Physics, Chemistry	Identical heating source; a shared set can serve both subjects.
Stand and clamp	Physics, Chemistry	Identical laboratory stand; share the same retort-stand stock.
Tongs	Physics, Chemistry	Same tool for handling hot objects; can be pooled.
Forceps	Physics, Biology	Same tool; one shared set (or duplicated cheaply) covers both labs' dissection/handling needs.
Watch Glass	Chemistry, Biology	Identical borosilicate item, used for evaporation in Chemistry and specimen viewing in Biology.
Wax	Chemistry, Biology	Same paraffin wax stock; used for sealing in Chemistry and for lining dissecting trays in Biology.

Annex II

Laboratory-wise Logbook Formats

Each discipline-specific lab shall maintain its own daily logbook using the format below, rather than a single shared STEM Lab log, so that discipline-specific risks (chemical use, specimen handling, component checkout) are properly tracked. Logbooks shall be reviewed by the subject teacher weekly and reconciled with the inventory register monthly per Section 3.2.

Physics Laboratory Logbook

Date	Class/Section	Experiment/Topic	Equipment Issued	Equipment Returned (condition)	Damage/Loss Noted	Teacher's Sign

Chemistry Laboratory Logbook

Date	Class/Section	Experiment/Topic	Chemicals Used (name & qty)	Waste Disposal Method	Safety Check (fume hood/PPE)	Teacher's Sign

Biology Laboratory Logbook

Date	Class/Section	Experiment/Topic	Specimens/Slides Used	Specimen Condition on Return	Microscope Unit No.	Teacher's Sign

Mathematics Laboratory Logbook

Date	Class/Section	Topic/Activity	Manipulatives/Kits Used	Software Used (if any)	Sets Returned Complete (Y/N)	Teacher's Sign

Robotics / DIY Laboratory Logbook

Date	Class/Section	Project/Activity	Components/Kits Checked Out	Components Returned (qty, condition)	Tools Used	Teacher's Sign

Annex III

Layout

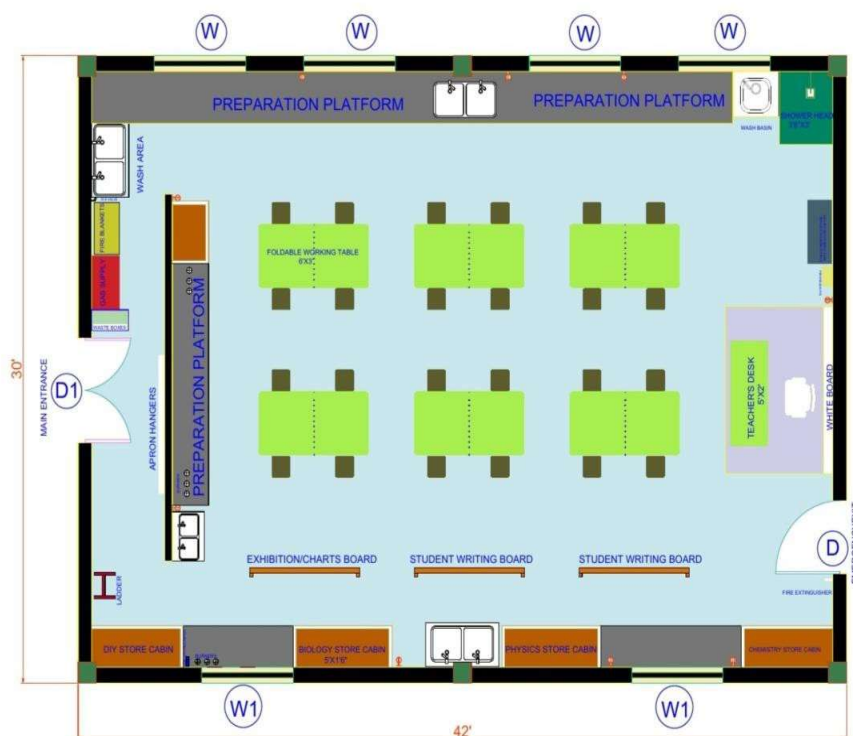


Figure 1: Layout of a school-level STEM lab having all required facilities

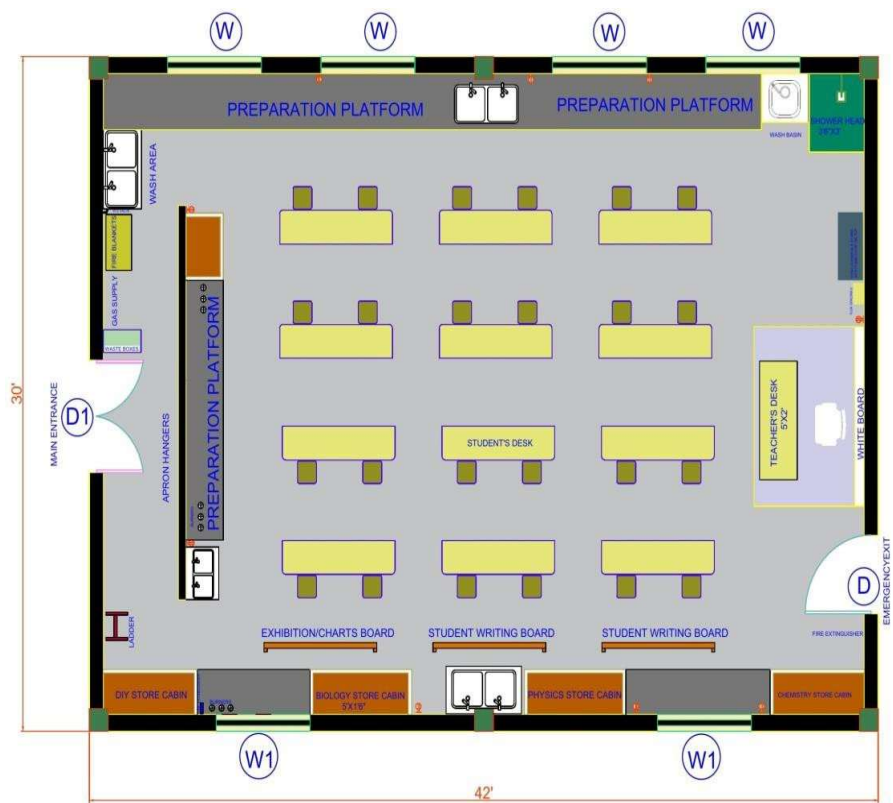
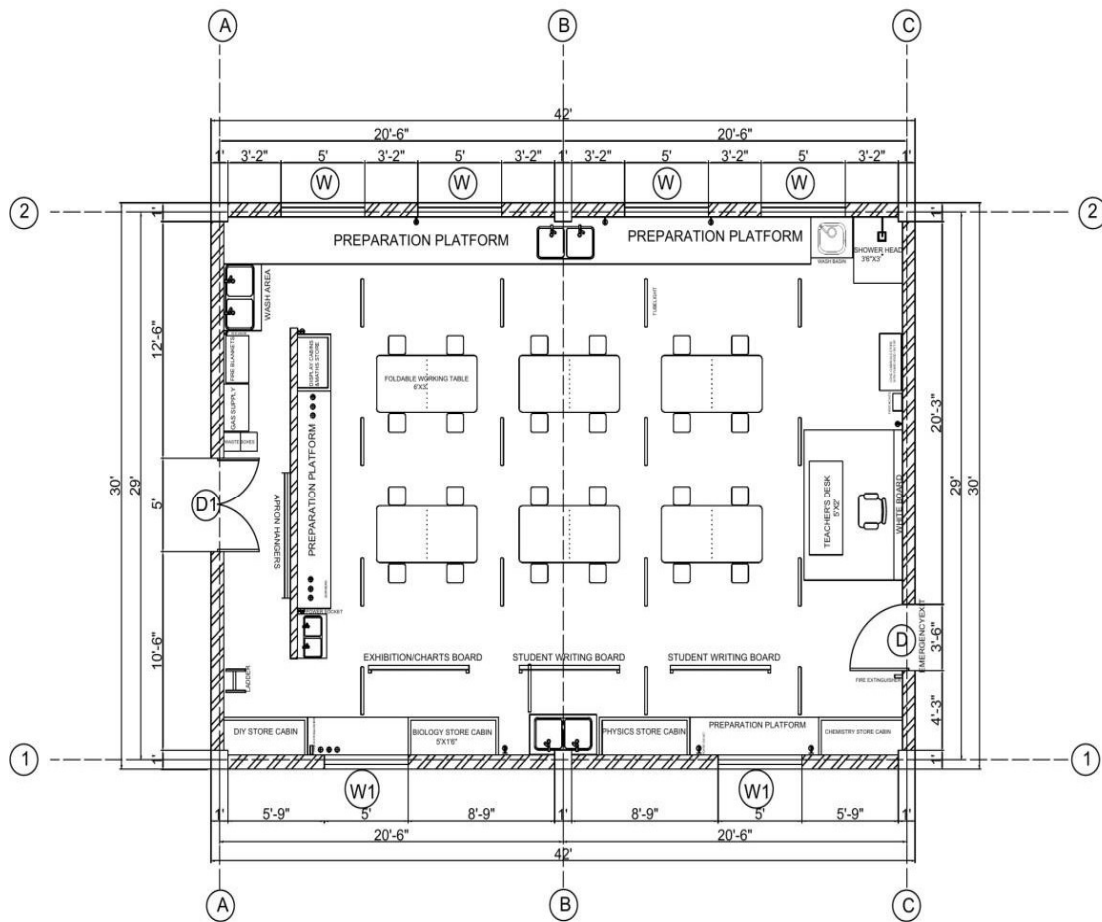


Figure 2: Alternative layout of a STEM lab



REVISED FLOOR PLAN STEM LAB

Figure 3: Architectural floor plan