



Epoxy Jewelry as STEM Project

Kseniia Minakova, Tetyana Tykhomyrova, Volodymyr Lebedev

National Technical University "Kharkiv Polytechnic Institute" Kharkiv, Ukraine

kseniia.minakova@khp.edu.ua

HSCI2020

1. Introduction

Any STEM project must meet the following criteria:

- 1) materials and equipment must be cheap, compact and not heavy in weight;
- 2) materials and equipment must be safe both for children and environment ;
- 3) project results should be achievable in short time, from 1 hour to 5 days;
- 4) STEM project should deepen the knowledge gained through the school curriculum or explain some theoretical material using hand-on science classes;
- 5) it should be interesting for boys and girls.

If we have as participants of STEM project children with special needs, than two new criteria are appeared:

- 1) easy for making and understanding sequencing looking for children's physical and mental condition;
- 2) shown children with special needs ways of their future ability to make business using ideas of given STEM project.

Not all STEM project can be successfully realized in groups, where common and children with special needs are together.

2. Materials for polymer jewelry

Among all different polymer materials for jewelry we have choose this one:

- 1) modified polyacrylamide (MPAM), that crosslinked by ultraviolet rays in 5-15 minutes (time depend on jewelry thickness);
- 2) epoxy resin (ER), that crosslinked without heating in 24 hours (using curing agent);
- 3) hydroxyethyl methacrylate with photo initiator hydroxycyclohexyl phenyl keton –well known material for nail art (HEM).

Their price and other characteristics are given in table 1.

1 kg of any polymer material is enough for making more than 100 examples of jewelry.

As fillers and additional materials for rings, bracelets, earrings, pendants, brooches you can use different materials, even diamonds. But we offer to use cheap or free materials:

- 1) wastes materials – broken glasses, old buttons, colorful plastic and metal wastes, coffee grounds;
- 2) floral materials – fresh and dried flowers and grass, branches, cones, coffee beans, tea;
- 3) natural materials – stones, colorful sand, shells and other materials for hand made.

Table 1. Characteristics chosen polymer materials

Polymer material	Price, \$, 1 kg	Substance hazard class	Special equipment for curing, yes/no, price, \$	Color palette
MPAM	6 5	3	yes, 15	4 base colors (yellow, green, red, blue)
ER	2 5	3	no	transparent
HEM	1 00	3	yes, 10	more than 20 base colors

Using of waste materials is the way for sustainable development of any country [2].

For jewelry's better appearance you can buy reusable silicone molds (Fig.1, a) and metal frame (Fig.1, b)

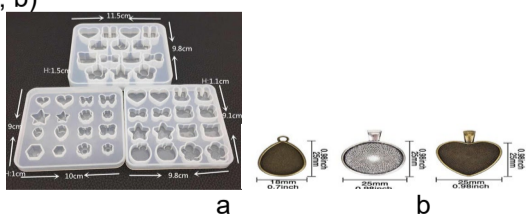


Figure 1. Illustration of molds and frames for jewelry

3. Processes, which demonstrated during this STEM project

In Ukraine children in secondary schools have different disciplines like biology, chemistry, physic that are not in one integral course but are being studied separate. Sometimes, depend on school program, topic from chemistry, which was studied in 8 classes,

repeated in 10 classes during studying physic. That is why STEM project, that can combine several school discipline are important.

Polymer ER, MPAM, HEM curing process illustrate following theoretical knowledge for children:

- from physic - transition from liquid to solid without changing temperature (heating or cooling) or pressure changing
- from chemistry - polymerization and polycondensation reaction;
- from ecology – environmental friendly technology of making jewelry, when nothing is emitted to atmosphere and no fusel fuel is burning for heating;
- from biology – light is essential not only for living organism (if you use HEM and MPAM)
- from physic – sunlight consist not only from visible light but also of ultraviolet light (if the weather is sunny you can make jewelry from MPAM without special lamp, open air)

4. Children with special educational needs in the given STEM project

Working together under some STEM project is useful both for common children and children with special educational needs. For three last years authors have hold more than 15 events like STEM projects, where common children and children with special educational needs were together. Some of them have been taken 2 hours, other – 2 weeks.

It was noted that the children with special educational needs are very happy about the opportunity to receive financial rewards for the manufactured material object. The money received from the sale of the making by their hand object becomes the incentive that forces them to continue classes on the STEM topic at home.

Fashion trends of five last years have shown an increase in popularity handmade decorations. Two last years in Eastern Europe one of the fashion trend is jewelry from epoxy resin with flowers. Their price is different (table 2)

Table 2. Price of epoxy resin jewelry

Jewelry	Sample	Price, \$US
rings		from 5 to 45
bracelets		from 30 to 75
earrings		from 10 to 80
pendants		from 7 to 50

As we see, selling such jewelry is real business.

5. Results of the given STEM project

The cheapest material, that doesn't need any additional equipment (ultraviolet lamp), is ER. But for curing you should mix epoxy resin with curing agent in clear proportion. For some children with special needs it can be difficult. Taking in the mind this problem, we decide to create jewelry, based on MPAM and HEM but also show them how to make jewelry based on ER.



Figure 2. Ultraviolet lamp or so calling 3D ultraviolet own

This STEM project was realized in Kharkov, Ukraine (winter 2020) during project "Holidays with Polytech".

Among participants there were 6 children with special educational needs.

First we explained children how MPAM comes solid in special ultraviolet lamp (fig.2).

We have made standard figure – sea horse (fig.3, a). Mould for it was included to set with 3D ultraviolet own (fig.3, b). We also show the possibility to mix two MPAM colors (red and yellow) and get new color (orange) in one object (fig.3, a).

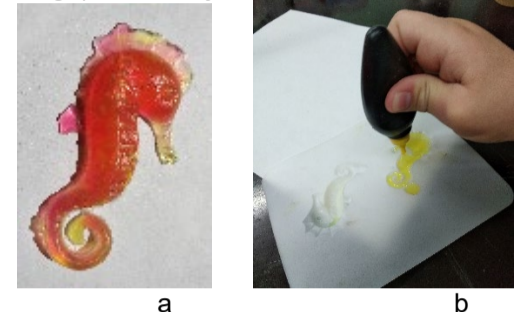


Figure 3. Sea horse from MPAM

Our second step was making pendants in silicon mould (fig. 4,a) and in metal frame (fig.4,b). As fillers children have proposed dried flowers (result at fig.5). Many children did their own herbarium during summer holidays. So, this material was free for us.

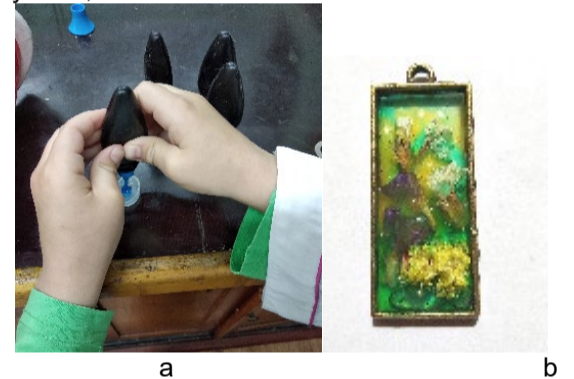


Figure 4. Making pendants from MPAM

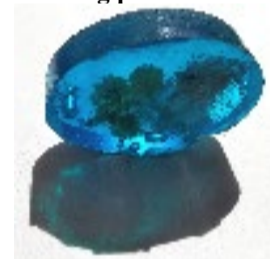


Figure 5. Blue pendant with flowers from MPAM

From ER we have made necklace beads (fig.6) with butterfly and flowers. If you add special pigments, you can receive colorful ER, not only transparent.

From HEM we made ring (fig.7). It consist of 6 layers of gel polish, including colorful layers and transparent layers of base and top coat. Also we use flowers and got original, extraordinary form of ring.



Figure 6. Necklace beads from ER



Figure 7. Ring from HEM

This STEM project was interesting for children. Teachers, who were with them, take into account this idea for their future project.