almost any engineering and technical discipline. STEAM is a tool that helps students take the first step towards understanding the complexity of the world and realising the multilevel connections between different aspects of life.

REFERENCES

1. Patrykeyeva O. STEAM-education: conditions of implementation in educational institutions of Ukraine. *Education Management*. 2017. №1. P. 28-31
2. State Scientific Institution Institute for Modernisation of Education Content [Electronic resource]. – Access mode: https://imzo.gov.ua/
3. STEAM-education: an innovative scientific and technical system of education [Electronic resource]. – Access mode: http://ippo.kubg.edu.ua/content/11373

A. Polyakov, N. Zamova, T. Vorova

DESIGN AND REUSE CYCLES

Environmental product design begins by eliminating environmentally troublesome materials. For instance, plated-metal parts are “designed out” to eliminate the potential hazards of plating, or the metal is coated in other ways. Paint and coating formulas now rarely use mercury fungicides or lead. Whenever possible, water-based paints eliminate the evaporation of organic solvents. The best way to handle hazardous waste is to have none. Design for disassembly (DFD) promotes remanufacturing and recycling. A well-publicized DFD automobile is BMW’s Zl sportster. It uses pop-on, pop-off fasteners and thermoplastic parts, which can be recycled, in place of thermosets, which cannot. By contrast, the low recycle value of Japanese auto design and lower scrap-iron prices have recently driven Japanese “car cannibalizers” out of business [2].

BMW’s Zl design extends the basic concept of Saturn. The cars’ underbodies have detachable plastic panels. A Saturn rammed by a pickup truck recently demonstrated an advantage of the design for repair. The body panels were removed, the underframe straightened, and the same panels remounted. Having a large number of parts obviously adds time to both assembly and disassembly. Well-

established methods of design for assembly that reduce part counts may also aid disassembly – if fasteners are removable. Complex fasteners are a pain. Screws take a lot of time to install: jam automated assembly equipment, then freeze when installed and refuse to peaceably disassemble. In addition, using a number of diverse materials creates problems in production. The more materials used, the harder to take them apart, and the more work to sort them [1].

Today's limits and trade-offs are challenges for the future. Now a high-density printed circuit board is not a DFD candidate, and tires may be recapped but not recycled. Modern tires are composites of different polymer compounds formulated for wear and performance in a given application. Composite frame parts increase strength-to-weight ratios, very important for lighter, more fuel-efficient cars – especially solar-powered ones. But composites designed to bind together for performance do not easily come apart for recycling. Much better to design items such as PC boards and tires for remanufacturing.

The marketing side of DFD presents an interesting opportunity. Initially, the concept may attract "green" buyers, but longer run, a return deposit on durables such as cars and computers would not have the same effect as with a soft-drink bottle. It does not even get the same response for an aluminum can. Instead, DFD represents another step in a manufacturing company becoming more like a service company. Combining DFD with modular design will let buyers periodically upgrade the purchase, much as they now buy newer versions of software.

DFD modular design presents possibilities for service by interchanging modules. In fact, if the original manufacturers do not compete with excellent service, one can easily imagine knock-off shops stealing it from them. That leads back to the environmental aspect of DFD: how to have social control of the dirt-to-dirt cycle of use. The basic concept is simple: do not sell product, sell a service process with products embedded in the service. Once customers sign on for service, they must return a product or module to get something else. If they want to sign on with a competitor, they return product. Provisions can be made for damage. The economics of this make no sense as long as materials, energy, and disposal are cheap. If these

are expensive, then enterprises that are superior at managing total recycling processes with customers will be able to beat the costs of competitors using throwaway methods. The system encourages maximum service competition with a minimum of Big Brother regulation. Real competition to improve the processes depends on open-system information.

REFERENCES

1. Hughes H. The Dangers of export pessimism: developing countries and industrial markets. San Francisco: ICS Press, 1992. 446 p.
2. Rachman D. Business today. New York; St. Louis; San Francisco: McGraw-Hill Publishing Company, 1990. 669 p.

Y. Polyvanov, N. Kondratiuk, O. Hurko

HYDROGELS IN THE CHEMICAL, PHARMACEUTICAL AND FOOD INDUSTRIES

Hydrogels are a system consisting of a polymer and water. It should be noted, that polymers have a long chain, which certainly gives them properties to form gels when dispersed in water. Depending on the available number of hydroxyl groups (-OH), which are also included in the composition of carboxyl groups (-COOH), hydrophilicity increases significantly, turning polymers into hydrocolloids.

It follows from the above that hydrogels in food products are able to change the consistency. This statement affects a number of key rheological properties, for instance, fluidity (viscosity) and texture. It cannot be denied that modifying of the texture and/or viscosity of a food system changes its sensory properties. In addition, such hydrocolloids as polysaccharides and proteins belong to the category of permitted food additives in many countries of the world. Scientists emphasize that in order to achieve the desired consistency and taste hydrogels are used in such dishes as cream soups, pureed soups, sauces, salad dressings, pastas, fillings use. Besides, hydrogels are also used in such food products as jellies, galyaret, jams,