Ministry of Education and Science of Ukraine
Sumy National Agrarian University
Faculty of Engineering and Technology
Department of Technical Service

Work program (syllabus) of the educational component

CC 6 – Modeling and planning a scientific experiment in engineering

(mandatory)

Implemented within the educational program Industrial Machinery Engineering
(name)

in specialty 133 "Industrial machinery engineering"
(code, name)

third (educational and scientific level) level of higher education

Sumy – 2023

Developers: _____, Tarelnyk V.B., Doctor of Technical Sciences, Professor, Head o the Department of Technical Sciences

(signature) (surname, initials) (academic degree and title, position)

Reviewed, approved and ratified at a meeting of the Technical Service Department (name of the department)	protocol of June 05, 2023 No. 17
	Head departments _____ (signature) Tarelnyk V.B. (last name, initials)

Agreed:

Guarantor of the educational program _____ (signature) V.B. Tarelnyk (full name)

Dean of the Faculty _____ (signature) V.M. Zubko (full name)

Review of the work program (attached) provided by: _____ V.M. Zubko (Full name)

_____ M.Yu.Dumanchuk (Full name)

Methodologist of the Department of Educational Quality, licensing and accreditation _____ N.M. Baranik

(signature)

Registered in the electronic database: date: 06.07. 2023.

Information on reviewing the work program (syllabus):

Educational the year in which are introduced changes	Number of the appendix to the work program with a description of the changes	Changes reviewed and approved		
		Date and number minutes of the meeting departments	Head of the Department	Guarantor educational programs

1. GENERAL INFORMATION ABOUT THE EDUCATIONAL COMPONENT

<table>
<tr><td>1.</td><td>Name CC</td><td colspan="4">Modeling and planning a scientific experiment in engineering</td></tr>
<tr><td>2.</td><td>Faculty/department</td><td colspan="4">Faculty of Engineering and Technology/Department of Technical Service</td></tr>
<tr><td>3.</td><td>Status CC</td><td colspan="4">Mandatory</td></tr>
<tr><td>4.</td><td>Program/Specialty (programs)</td><td colspan="4">Educational and scientific program "Industrial machinery engineering" in specialty 133 "Industrial machinery engineering"</td></tr>
<tr><td>5.</td><td>CC can be offered for (to be filled in for selective CCs)</td><td colspan="4"></td></tr>
<tr><td>6.</td><td>NQF level</td><td colspan="4">Level 8</td></tr>
<tr><td>7.</td><td>Semester and duration of study</td><td colspan="4">Daily
3rd semester, 10 weeks</td></tr>
<tr><td>8.</td><td>Number of ECTS credits</td><td colspan="4">3</td></tr>
<tr><td rowspan="3">9.</td><td rowspan="3">Total hours and their distribution</td><td colspan="3">Contact work (classes)</td><td>Independent work</td></tr>
<tr><td>Lectures</td><td>Practical / seminar</td><td>Laboratory</td><td></td></tr>
<tr><td>Daily
16</td><td>Daily
14</td><td></td><td>Daily
60</td></tr>
<tr><td>10.</td><td>Language of instruction</td><td colspan="4">Ukrainian, English</td></tr>
<tr><td>11.</td><td>Teacher/ Coordinator educational component</td><td colspan="4">Tarelnyk Viacheslav Borysovych, Doctor of Technical Sciences, Professor, Head of the Department of Technical Service
Consultation hours – every Monday from 10:00 to 12:00, room 302m</td></tr>
<tr><td>11.1</td><td>Contact information</td><td colspan="4">viacheclav.tarelnyk@snau.edu.ua</td></tr>
<tr><td>12.</td><td>General description of the educational component</td><td colspan="4">The discipline will be useful for future specialists to acquire in-depth competencies necessary for use in scientific activities, in particular, theoretical knowledge and practical skills in using applied computer programs, computer mathematics systems and modeling tools in order to increase the reliability of obtaining scientific and practical research results and the effectiveness of their presentation. Mastery methodological and methodological foundations of modeling experiments in engineering research, and acquiring practical skills and abilities in their organization and conduct in the specialty "Industrial Mechanical Engineering".</td></tr>
<tr><td>13.</td><td>Purpose of the educational component</td><td colspan="4">It consists in the acquisition by applicants of the principles and methods of formalizing models of technological processes and technical systems in the field of engineering research, acquiring skills in using modern software to solve scientific problems at the stage of modeling, data processing and visualization of analytical dependencies with the integration of research results into qualification work.</td></tr>
<tr><td>14.</td><td>Prerequisites for studying CC, connection with other educational components of ESP</td><td colspan="4">The discipline is based on CC 2 "Modern information technologies in scientific activity" and CC 4 " Research Methodology"</td></tr>
<tr><td>15.</td><td>Academic Integrity Policy</td><td colspan="4">If a candidate submits another candidate's work as their own, such work is canceled and retaken.
In case of cheating, retake the corresponding assignment.
In case of using text borrowings without proper citation (academic</td></tr>
</table>

		plagiarism), the work will be canceled.
16.	Link to the course in Moodle system	https://cdn.snau.edu.ua/moodle/course/view.php?id=1085

2. **LEARNING OUTCOMES BY EDUCATIONAL COMPONENT AND THEIR RELATIONSHIP WITH PROGRAM LEARNING OUTCOMES**

Learning outcomes for CC: After studying the educational component, the applicant is expected to be able to...	Program learning outcomes that the CC aims to achieve (indicate the number according to the numbering given in the ESP)					How is the LOA assessed?
	PLO					
	PLO 1	PLO 3	PLO 4	PLO 6	PLO 8	
LOA 1. Have methodological and methodological foundations of modeling experiments in engineering research	X			X		Individual task
LOA 2. Carry out a formalized description of the research object, checking the adequacy of the resulting model.		X	X		X	Individual task
LOA 3. Make scientifically sound choices of modeling and experimental design methods to be used	X	X			X	Individual task
LOA 4. Possess modern equipment for processing and interpreting experimental data		X	X	X	X	Individual task Analyticalreview with presentation

PLO 1. Have conceptual and methodological knowledge in mechanical engineering and at the border of subject areas, as well as research skills sufficient to conduct scientific and applied research at the level of the latest world achievements in the relevant field, obtain new knowledge and/or implement innovations. PLO 3. Be able to conduct critical analysis, evaluation and synthesis of new scientific provisions and ideas regarding the construction and operating conditions of machines and equipment, their complexes and systems. Analyze modern scientific works, identifying controversial and little-researched issues in the field of mechanical engineering.

PLO 3. Formulate and test hypotheses; use appropriate evidence to substantiate conclusions, in particular, the results of theoretical analysis, experimental studies and mathematical and/or computer modeling, and available literature data.

PLO 4. Develop and research conceptual, mathematical and computer models of processes and systems, effectively use them to obtain new knowledge and/or create innovative products in mechanical engineering and related interdisciplinary areas.

PLO 6. Develop and implement scientific and/or innovative engineering projects that provide an opportunity to rethink existing and create new holistic knowledge and/or professional practice and solve significant scientific and technological problems in mechanical engineering while adhering to the norms of academic ethics and taking into account social, economic, environmental and legal aspects.

PLO 8. Apply general principles and methods of mathematics, natural and technical sciences, as well as modern methods and tools, digital technologies and specialized software to conduct research in the field of mechanical engineering.

3. CONTENT OF THE EDUCATIONAL COMPONENT (COURSE PROGRAM)

Topic. List of issues to be addressed within the topic	Distribution within the general time budget				Recommended reading
	Classroom work			Independent work	
	Lec	PC	Lab		
Topic 1. Models. Modeling in Engineering Basic concepts and definitions. Goals and principles of modeling. Axioms of modeling theory. Types of models and modeling. Model functions. Factors influencing the object model. Mathematical modeling. Requirements for a mathematical model. Structure of a mathematical model. Classification of mathematical models. Goals of mathematical modeling for technical objects and technological processes. Algorithm for building a model. Modeling technologies. Algorithm for building an analytical model. Algorithm for building an empirical model. Brief description of the main stages of algorithms for building analytical and empirical models.	2	-		10	1-8, 15, 20, 22, 23, 25-28
Topic 2. Systems modeling methodology. Logic of system analysis. Formation of general ideas about the system. Identification of the purpose, goal, main objectives, functions of the system properties. Formation of basic subject concepts used in the system. Formation of in-depth ideas about the system. Modeling of the system as a stage of its research. Systematic approach to modeling. Concepts of system and model. Models of statics and dynamics, models of transformation processes and systems. Developed classification of mathematical models. Deterministic and stochastic models. Dynamic and static models. Automatic, semi-automatic and integrated modeling.	2	-		10	1-4, 7, 8, 11
Topic 3. Methods of researching models. Monte Carlo method. Simulation modeling. Formulation of the simulation modeling problem. Simulation modeling method. Typical implementation scheme. Accuracy of mathematical modeling. Dynamic systems with lumped parameters. Oscillations in mechanical systems. Single-mass and multi-mass systems. Damping of oscillations. Linear and nonlinear systems. Dynamic similarity and modeling of phenomena, processes and systems. Concepts of identification. Identification experiment. Identification of algorithmic and information models. Identification methods. Computational experiments using mathematical models. Analytical and numerical modeling. Application of mathematical apparatus for modeling technical systems. Errors and properties of computational methods and algorithms. Methods of processing experimental data. Interpolation, approximation, statistical and digital data processing	2	-		10	1, 2, 7-9, 11, 12, 13, 15
Topic 4. Software for device and system modeling Application of the package for automation of physical processes. Real and virtual physical devices and systems. Description of physical processes using LabView programs. Virtual device libraries. Language and graphics of the LabView software	4	4		10	9, 10, 15, 19, 29, 30

package, user interface. Structure of the LabView language. Set of virtual devices. Functional set. Graphics in LabView. Control elements of virtual devices and indicators. Programming of operations. Arithmetic and Boolean operations in LabView. Actions with data arrays and strings. Clusters and operations with them. Structures and cycles. Methods of creating virtual physical devices, data processing. Methods of data collection in physical experiments. Automation of data collection using computer and measurement technologies of the LabView software package. Hardware part of data collection systems. Devices and input/output boards of National Instruments. Examples of data collection in physics and engineering. Basic information about the Simulink mathematical modeling package. Basic capabilities of the Simulink extension package. General principles of operation in the Simulink package. Working with demonstration examples. Basics of operation in the Simulink package. Library of modules (blocks) of the Simulink package. Recorders. Sources. Typical dynamic links. Built-in mathematical functions. User functions. Typical dependencies. Complex signals and systems. Construction of block diagrams of dynamic systems. Features of modeling linear systems in the Simulink package. Problem formulation. Model creation. Model construction block diagram. Model launch. Features of modeling nonlinear systems in the Simulink package. Problem formulation. Model creation. Model construction block diagram. Model launch.					
Topic 5. Experimental planning methodology Orthogonal first-order designs. Full factorial experiment. Reproducibility variance. Assessment of the adequacy of the approximating dependence of the object under study. Assessment of the significance of the coefficients of the approximating dependence taken in the form of an algebraic polynomial, in the sense of the difference of the values of these coefficients from zero. Processing of the experimental results. Small factorial experiment. Drawing up second-order designs. Orthogonal central-composition designs. Designing an experiment when searching for an experimental area. Classical methods for determining the extremum. Factorial methods for determining the extremum. Analysis of variance in experimental research. Single-factor analysis of variance.	2	4		10	1, 8, 9,10, 16, 19, 29, 30
Topic 6. Specialized mathematical data processing software products MathCAD working environment. Basics of calculations in MathCAD. Entering and editing formulas. Graphical capabilities. Basics of working in MathCAD. Algebraic calculations in MathCAD. Operators. Functions. Algebraic transformations. Performing symbolic calculations in MathCAD.	4	6		10	15, 17-21, 31-34

Numerical solution of mathematical problems. Numerical differentiation. Numerical integration. Solving nonlinear algebraic equations. Solving systems of linear algebraic equations. Performing numerical calculations in MathCAD. Working in MathLAB. General information about MathLAB. Constructing graphs and surfaces. Basics of programming in MathLAB. Programming branched computational processes. Programming branched computational processes. Programming cyclic computational processes. Programming cyclic computational processes. Creating user procedures and functions. Numerical calculations. Integration and differentiation. Solving equations and systems of equations. Working with the Statistica program. Basics of working with the Statistica program. Program interface. Organization of derived data. Working with data files. Modular structure of the program. Creating a data file in the Statistica program. Calculating descriptive statistics in the Statistica program. Arithmetic mean. Sample mean. Sample variance. Standard deviation. Mode. Median. Quantile. Using the Statistica program for primary data analysis. Using the probability calculator. Building and editing statistical graphs. Generating random numbers. Determining the main parameters of probability distributions.					
Total	**16**	**14**		**60**	

4. TEACHING AND LEARNING METHODS

LOA	**Teaching methods**(work that will be carried out by the teacher during classroom lessons, consultations)	**Number of hours**	**Teaching methods**(what types of learning activities should the student perform independently)	Number of hours
LOA 1. Have methodological and methodological foundations of modeling experiments in engineering research	Problem lecture, thematic discussion, "Round table", discussion of current issues.	4	Independent work with the textbook, study of theoretical material.	10
LOA 2. Carry out a formalized description of the research object, checking the adequacy of the resulting model.	Multimedia lecture, teacher consultations, discussion of current issues.	10	Independent work with the textbook, completion of individual tasks.	20
LOA 3. Make scientifically sound choices of modeling and experimental design methods to be used	Multimedia lecture, "brainstorming", discussion of current issues.	10	Personalized learning, independent work with the textbook, completion of individual tasks.	20
LOA 4. Possess modern equipment for processing and interpreting experimental data	Flipped classroom, learning through action, teacher consultations, thematic discussion.	6	Independent work with the textbook, learning through research.	10
Total hours		30		60

5. EVALUATION BY EDUCATIONAL COMPONENT

5.1. Diagnostic assessment (indicated as needed)

5.2. Summative assessment:

5.2.1. To assess the expected learning outcomes, there are

No.	Summative assessment methods	Points / Weight in the overall score	Date of compilation
1.	Completing an individual task	*25 points / 25%*	*For 4 weeks*
2.	Completing an individual task	*25 points / 25%*	*At 6 weeks*
3.	Completing an individual task	*25 points / 25%*	*At 8 weeks*
4.	Analytical review with presentation (credit)	*25 points / 25%*	*At 10 weeks*

5.2.2. Criteria evaluation

Component	Unsatisfactorily	Satisfactorily	Good	Perfectly
Execution of individual this task	*<11 points*	*11-15 points*	*16-21 points*	*22-25 points*
	Minor awareness regarding the problem, given short description. Does not demonstrate independence thinking about selected topic.	Given in larger as far as problem description (without analysis), insufficient justification highlights, not enough consistent argument, presentation missing or submitted superficially. Processed only literature that recommended teacher.	Demonstrated understanding, depth and/or or detailing problems; main problematic aspects justified, arguments are consistent; various points are studied view, the presentation is meaningful, consistent. Processed literature only recommended teacher.	Quite deep and/ or detailed problem, different views on the problem were analyzed; all the main points are stated, the arguments consistent and weighty; various are analyzed points of view are given own suggestions.
Analytical review with presentation (credit)	*<11 points*	*11-15 points*	*16-21 points*	*22-25 points*
	Task of requirements not met	Majority requirements completed, but individual components are missing or insufficiently disclosed, missing analysis of other approaches to the question	All task requirements met	All task requirements have been met, creativity, thoughtfulness have been demonstrated, and the original proposal has been proposed. problem solving

5.3. Formative assessment:

To assess current progress in learning and understand areas for further improvement,

No.	Elements of formative assessment	Date
1	Computer simulation with elements of problem tasks	During classes
2	Verbal feedback from teacher and students while completing an individual task	During classes
3	Verbal feedback from teacher and students regarding the analytical review with presentation	Week 10

6. LEARNING RESOURCES (LITERATURE)

6.1. Main sources:

1. Yerina A.M., Zakhozhiy V.B., Yerin D.L. Methodology of scientific research: Textbook. – Kyiv: Center for Educational Literature, 2004. – 212 p.
2. Mokin B. I. Mathematical methods of identification of dynamic systems: a textbook / B. I. Mokin, V. B. Mokin, O. B. Mokin. – Vinnytsia: VNTU, 2010. – 260 p.
3. Ludchenko A. A., Ludchenko Ya. A., Primak T. AND. Fundamentals of scientific research: Textbook. Manual / Ed. AND. AND. Ludchenko. - K.: "Knowledge" Oblast, KOO, 2002. - 114 p.
4. Narynyan A.R. Foundations of scientific research. Study guide for universities. / Narynyan A.R. - K.: 2002. - 112 p.

5. Foundations of scientific research. Study guide for universities. \ Frumkin R.A. – Alchevsk., 2001 -201 p.
6. Sidenko V. M., Grushko I. M. Fundamentals of Scientific Research. – Kharkiv, Higher School, 2002 – 200 p.
7. Sheiko V.M., Kushnarenko N.M. Organization and methodology of scientific research activity: Textbook. – 2nd ed., revised and supplemented. – K.: Znannya-Press, 2002. – 295 p.
8. Yerina AM Statistical modeling and forecasting: a textbook. / A. M. Yerina. - Ternopil: University Book, 2005. - 170 p.
9. Koshevy, M.D. Optimal planning of experiments in the study of technological processes, devices and systems: a manual/ [M.D. Koshevy, O.M. Kostenko, O.V. Zabolotny and others]. – Kh.: National Aerospace University "Kharkiv Aviation Institute", 2010.– 161 p.
10. Cheremnykh E.V. and others, Theory of experiment planning and examples of its application: teaching aids. / E.V. Cheremnykh, T.M. Salo. — L.: Publishing House of the National University "Lviv. Polytechnic", 2005. — 148 p.
11. Rajagopal K. Operations research / K. Rajagopal. - PHI Learning Pvt. Ltd., 2012. - 608 p.
12. Mayboroda R.E. Regression / R.E. Mayboroda. – K.: TViMS, 2004. – 283 p.
13. S.G. Radchenko Formalized and heuristic solutions in regression analysis: monograph / S.G. Radchenko. - K.: Korniychuk, 2015. - 235 p.
14. Nazarenko L.A. Planning and processing of experimental results: lecture notes. — Kharkiv: KhNAMG, 2008. — 163 p.
15. Tomashevsky O.V. Computer technologies of statistical data processing / O.V. Tomashevsky, V.P. Rysikov. – Zaporizhzhia: ZNTU, 2015. — 175 p.
16. Cheremnykh E.V. Theory of experimental planning and examples of its application: a textbook / E.V. Cheremnykh, T.M. Salo. - Lviv: Publishing House of the National University "Lviv Polytechnic", 2005. - 148 p.

6.2. Additional sources:

17. Kundrat A.M., Kundrat M.M. Scientific and technical calculations using MathCAD and MS Excel. Textbook. Rivne: NUVGP, 2014. – 252p.
18. Mayboroda R.E., Sugakova O.V. Statistical data analysis using the STATISTICA package. Textbook (2012) [Electronic resource]. – Access mode:https://bit.ly/3BI4keB
19. Steinhaus S. Comparison of Mathematical Programs for Data Analysis (Edition 5.03) [Electronic resource] – Munchen/Germany. – 64 p. – Access mode:https://bit.ly/3p5A34x
20. Lazarev Yu. Modeling processes and technical systems in MATLAB. Training course. - Kyiv: Izdatelskaya gruppa BHV, 2004. - 474 p.
21. Devin V.V., Tkachuk V.S. Solving point kinematics problems using the MathCAD system// Actual scientific studies in the modern world// Sat. scientific works - Pereyaslav-Khmelnytskyi. 2018. (3). C.128-135 URL:https://elibrary.ru/item.asp?id=32763343
22. Ie. Konoplianchenko et al. Mathematical Modeling a Process of Strengthening Steel Part Working Surfaces at Carburizing Thereof by Electroerosive Alloying Method. (2018) AIP Conf. Proc. 2017: 020008-1–020008-14.https://doi.org/10.1063/1.5056271.
23. V. Tarelnyk, Ie. Konoplianchenko, N. Tarelnyk, A. Kozachenko, "Modeling Technological Parameters for Producing Combined Electrospark Deposition Coatings", Materials Science Forum, Vol. 968, pp. 131-142, 2019. https://doi.org/10.4028/www.scientific.net/MSF.968.131
24. Häse, F., Aldeghi, M., Hickman, RJ, Roch, LM, Christensen, M., Liles, E., Hein, JE, Aspuru-Guzik, A. Olympus: A benchmarking framework for noisy optimization and experiment planning (2021) Machine Learning: Science and Technology, 2 (3), art. no. 035021.https://doi.org/10.1088/2632-2153/abedc8
25. Zhao, X., Pan, J., Li, L. Research of Integrated Impeller Modeling and Five-axis Machining Technology based on Reverse Engineering (2021) Journal of Physics: Conference Series, 1865 (3), art. no. 032037.https://doi.org/10.1088/1742-6596/1865/3/032037

26. Hofelich, M., Mantel, KV, Bursac, N., Omidvarkarjan, D., Matthiesen, S., Meboldt, M., Schneider, T. Attributes of research environments for modeling engineering simulators for design support validation (2021) Procedia CIRP , 100, pp. 678-683.https://doi.org/10.1016/j.procir.2021.05.143
27. Horvath, L. Research Configuration of Engineering Modeling Platform (2020) SACI 2020 - IEEE 14th International Symposium on Applied Computational Intelligence and Informatics, Proceedings, art. no. 9118812, pp. 261-266.https://doi.org/10.1109/SACI49304.2020.9118812
28. Guo, M. Engineering-oriented modeling and experimental research on DC-biased transformers (2019) Modeling and Application of Electromagnetic and Thermal Field in Electrical Engineering, pp. 587-664.https://doi.org/10.1007/978-981-15-0173-9_15
29. Koshevoy, N.D. Methodology for increasing the efficiency of experimental research / N.D. Koshevoy, E.M. Kostenko // Integrated intellectual robotic complexes (IIRTK-2009): abstracts of the second international scientific and practical conference, May 25–28. – K.: NAU, 2009.– P.165 - 166.
30. Afanasyeva N. Yu. Computational and experimental methods of a scientific experiment / N. Yu. Afanasyeva, 2010. - M. : KnoRus, 2010. – 330 p.
31. Official Mathcad website. [Electronic resource] – Access mode:http://mathcad.com.ua/
32. Official Matlab website. [Electronic resource] – Access mode:https://www.mathworks.com/
33. Official website of Smath Studio [Electronic resource] – Access mode:http://en.smath.info/
34. Maxima official website. [Electronic resource] – Access mode:http://maxima.sourceforge.net/

6.1 English-language Internet resources

Online organizers

Docollab– Helps to manage scientific research, collaborate with colleagues and publish findings.
Elabftw– Electromic lab notebook made by researchers, for researchers, with usability in mind.
ELabJournal– GLP-compliant Electronic Lab Notebook and lab management tool.
Evernote– A place to collect inspirational ideas, write meaningful words, move important projects forward.
Findings App– Lab notebook app that allows to organize experiments, keep track of results, manage protocols.
Hivebench– Hosted numeric laboratory notebook tool to manage protocols, experiments, share with team.
Journal Lab– A community of scientists who share open summaries and peer review of articles.
LabArchives– Web-based product to enable researchers to store, organize, and publish their research data.
Labfolder– Simple way to document research and to organize protocols and data.
LabGuru– Supports day to day activities of a research group (vision, execution, knowledge, logistics).
Laboratory Logbook– Document projects running in a lab, manage experimentally obtained data, metadata.
sciNote– Open source lab notebook with workflows and modular functionalities.
Sumatra– Automated electronic lab notebook for computational projects.

Tools for collaborative experimentation

Emerald Cloud Lab– A web-based life sciences lab, developed by scientists for scientists.
ScienceExchange– Marketplace for shared lab instrumentation.
TetraScience– Allows you to monitor & manage experiments from anywhere.
Transcript– A remote, on-demand robotic life science research lab with no hardware to buy or software to install.

Addgene– Plasmid sharing platform.
Antibody Registry– Gives researchers a way to universally identify antibodies used in the course of research.
ELabInventory– Web laboratory inventory management system designed for life science research labs.
Nanosupply– Platform facilitating sourcing and sharing of advanced materials for research and education.
Sample of Science– Peer-Sharing Platform for Scientific Samples.

Electronic laboratories

BioBright– For better understanding of experimental conditions by connecting sensors to instruments.

Sharing samples for research

Addgene– Plasmid sharing platform.
ELabInventory– Web laboratory inventory management system designed for life science research labs.
Nanosupply– Platform facilitating sourcing and sharing of advanced materials for research and education.
Sample of Science– Peer-Sharing Platform for Scientific Samples.

Archive of experimental protocols

SciVee– Science video sharing platform that includes protocols.
Benchfly– Video protocols and video platform for scientists.
Benchling– Life science data management and collaboration platform to create, find, and discuss protocols.
IPOL journal– Research journal of image processing & analysis with algorithm descriptions and source code.
MyExperiment– Share workflows and in silico experiments.
Pegasus– Platform that helps workflow-based applications execute.
Online protocol– A curator of protocols contributed by researchers around the world.
Scientific Protocols– Share scientific protocols using the GitHub platform.

Working with data

Datazar– Research collaboration platform where you can easily explore, use and share data.
Data data– Open source, decentralized data tool for distributing small and large datasets.
Delve Health– Comprehensive source of real-time intelligence focused on life science research industry.
Kaggle– Platform for data prediction competitions.
Kitware– Advanced software solutions and services for data intensive R&D.
mloss– Machine learning open source software.
MyExperiment– Share workflows and in silico experiments.
nanoHUB– Centralized platform for computational nanotechnology research, education, and collaboration.
Ovation– Simplifies scientific life from sample tracking for startup labs to data management.
PCR Drive– Free platform that supports researchers in all their PCR-related processes.
Pegasus– Platform that helps workflow-based applications execute.
Plotly– Online tool to graph and share data.
Riffyn- Cloud software for visual, collaborative, reproducible innovation.
ROpenSci– Access to data repositories through the R statistical programming environment.
Statcrunch– Provides data analysis via the Web.
Sumatra– Automated electronic lab notebook for computational projects.
SURF In context– Navigate through RDF relations in a smooth and understandable way.
Sweave– Allows to embed the R code for complete data analyzes in latex documents.

Synapse– Platform to support open, collaborative data analysis for clear, reproducible science.
System in Cloud– Platform, enabling clients to quickly draw and execute data-flow diagram that runs in the cloud.
Tableau– Easily and quickly analyze and present data and share insights.
Tavern– A suite of tools used to design and execute scientific workflows.
VisTrails– Scientific workflow & provenance management system that supports data exploration.
Wakari- Web-based python data analysis.
WebPlotDigitizer– Web-based tool to extract data from plots, images, and maps.
Wings– Semantic workflow system that assists scientists with the design of computational experiments.
Wolfram Alpha– Web-based tools for scientific calculations.
World Map– Allows users to explore, visualize, edit, collaborate with, and publish geospatial information.