PSI*
Physics Student Innovators
(*and alumni)

Knowledge Domains for the *Compleat Physicist*

https://www.spsnational.org/programs/outreach/psistar

Foundational Disciplines

Physics Subdisciplines

01 Mechanics & Nonlinear Dynamics
02 Electromagnetism
03 Thermal & Statistical Physics
04 Fundamental Quantum Phenomena
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05 Nuclear & Elementary Particle Physics
06 Atomic & Molecular Physics
07 Optics & Photonics
08 Condensed Matter Physics

09 Fluid Dynamics
10 Acoustics & Ultrasonics
11 Plasma Physics
12 Astronomy, Astrophysics, Cosmology & Gravitation
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13 Biophysics & Medical Physics
14 Chemical Physics & Physical Chemistry
15 Polymer & Soft Matter Physics
16 Mesoscopic Physics & Nanoscience

17 Complex Systems & Networks
18 Physics and Information
19 Geophysics, Ocean Physics & Atmospheric Physics
20 Environmental Physics

21 Physics in Archeology & Anthropology
22 Sociophysics & Econophysics
23 Art & Physics
24 Physics Education Research
25 History of Physics

Math & the Other Sciences

Mathematics
Chemistry
Biology
Earth Sciences
Environmental Science
Geography

Engineering

Mechanical Engineering
Electrical Engineering
Computer Engineering
Civil Engineering
Industrial Engineering
Architectural Engineering
Chemical Engineering
Bioengineering
Automotive Engineering
Aerospace Engineering
Naval Engineering
Ocean Engineering
Geotechnical Engineering
Environmental Engineering

Art, Humanities, Psychology & Social Sciences

Writing & Rhetoric
Languages & Cultures
Classics
Philosophy & Religious Studies
Value & Aesthetics
Ethics

Poetry
Literature
Creative Writing
Visual Art &Photography
Architecture & Design
Sculpture
Crafts
Music
Dance
Theater & Film

History
Anthropology & Archeology
Ethnic & Gender Studies
Psychology
Sociology
Political Science
Economics

Education and Human Development

(many fields corresponding to topics of learning and stages of development)

Technologies, Methods, and Skills

Technical Repertoire

01 Design & early prototyping
02 Safety & hazardous materials
03 Hand tools & handheld power tools
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04 Materials
05 Fabrication
06 Chemical methods

07 Energy systems
08 Measurement & sensors
09 Spectroscopic & analytical instrumentation

10 Structural systems
11 Buildings, labs & work areas
12 Geotechnics, hydraulics & land engineering
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13 Machines & mechanisms
14 Actuators
15 Vehicles

16 Rigging & materials handling
17 Rotating, vibrating & chaotic systems
18 Sound & ultrasound

19 Fluid systems
20 Thermal systems
21 Vacuum & high pressure
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22 Electronic test & measurement
23 Analog electronics & electronics construction
24 Radio frequency & microwave systems

25 Digital logic, FPGAs, microprocessors & microcontrollers
26 Computer-integrated data acquisition & control

27 Human interfaces
28 Control systems

29 Mechatronics, robotics & automation
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30 Computers, clusters & servers
31 Memory, data storage & input-output
32 High data throughput, neural networks & artificial intelligence

33 Signal processing
34 Networks & communication systems
35 Geospatial systems & internet of things
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36 Optics & optical systems
37 Lasers & photonics
38 Imaging & remote sensing

39 Electric fields & plasmas
40 Magnetic fields & superconductors
41 Charged particle optics & instruments
42 Nuclear & elementary particle methods
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43 Microscopy & micromanipulation
44 Thin films, microfabrication & microdevices
45 Nanoscale microscopy & measurement
46 Nanotechnology & atom manipulation
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47 Molecular biology methods
48 Cell & microbiology methods
49 Plant & animal biology methods
50 Biomedical devices, instrumentation & imaging
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51 Field work & outdoor skills
52 Extreme environments & space systems

Analytical Repertoire

Coordinate systems & trigonometry
Geometry
Vector analysis
Tensors
Linear algebra
Group theory
Complex variables & analysis
Ordinary differential equations
Special functions
Integral transforms
Fourier analysis
Orthogonal function expansions
Partial differential equations
Integral equations
Calculus of variations
Topology

Statistical Repertoire

Discrete probability & combinatorics
Probability distributions
Bayesian statistics
Regression analysis
Experiment design & quality control
Stochastic processes
Stochastic differential equations
Time series analysis & prediction
Game theory & agent-based models
Evolutionary methods & annealing

Computational Repertoire

Computational Environments
Mathematica
Matlab / Simulink
CAD including stress computation
Comsol Multiphysics

Numerical Methods
Root finding
Linear algebra
  Matrix inversion
  Eigenvalues
Optimization
Integration
Ordinary Differential Equations
Partial Differential Equations
  Finite Difference
  Finite Element
  Spectral
Stochastic Methods
Image processing

Operating systems
  Linux / Android / MacOS / IOS
  Windows

Code & Website Development
Version control
  Github
Programming languages
  C/C++
  Python / Julia
  Java
  R / IDL / SQL
  LabVIEW
Web Development
  HTML / CSS
  mySQL
  Javascript / PHP/Perl/Ruby
  Django /Rails
  Drupal / Joomla / Wordpress / Squarespace
Parallel computing CUDA
Mobile device development

Data Science
Machine learning & artificial intelligence
Data visualization
Data assimilation

Workflow Repertoire

Tools For Managing Research & Innovation
01 Finding ideas, needs & opportunities
02 Literature and preparatory learning
03 Project planning
04 Project management
05 Tools that support theoretical work
06 Code management
07 Managing apparatus / prototype design & construction
08 Protocol development & automation
09 Performing & documenting lab/shop/studio work & observations
10 Data management, analysis & display
11 Tools for assessing results
12 Dissemination
13 Planning further iterations, pivots, spin-offs & new directions

Physics Teaching Repertoire

Identifying learning outcomes
Designing hierarchical instruction
Exhibiting methods of thought
Creating examples & problems
Using classroom presentation platforms
Using computer tools for learning
Performing demonstrations
Identifying student misconceptions
Developing active learning modules
Recognizing student individual learning
Fostering group interaction
Supporting diversity and inclusion
Assessing student knowledge and skills
Curriculum evaluation and assessment

Business & Entrepreneurship Repertoire

Need finding & customer discovery
Fostering creativity and innovation
Intellectual property
Product definition and pricing
Market segments and revenue estimation
Business planning
Pitches & business communication
Teamwork & leadership
Work definition & management
Marketing
Creating & managing organizations
Human resources & supervision
Finance, accounting & insurance
Global partners & markets
Production planning & management
Supply chain management
Customer relations
Business law
Regulatory compliance
Business history & biography

Legal and Civics Repertoire

(many fields that are aligned with the areas of human application and general aspects of citizenship & government)

Impact

Human Applications

01 Energy
02 Air & water
03 Food
04 Ecosystems, weather & environment

05 Dwellings & the built environment
06 Things for daily living
07 Maintenance, recycling & disposal
08 Transportation

09 Family, friends & community
10 Health
11 Education
12 Safety & security

13 Information & communication
14 Art, craft, hobbies & entertainment
15 Sports & recreation
16 Hospitality & personal services

17 Materials production
18 Manufacturing
19 Technical supplies, equipment & services

20 Marketing, distribution, sales & rental
21 Finance, insurance, & real estate
22 Management, legal services & government

23 Exploration
24 Future humans

∞ Creating knowledge

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