Il Documento di pianificazione e di organizzazione delle attività formative e di ricerca viene richiesto al Corso di Dottorato prima dell'inizio di un nuovo ciclo del corso di dottorato. Ai contenuti del DPO viene data adeguata visibilità nel sito web del corso ai fini dell'attrattività e della trasparenza. Il DPO viene eventualmente aggiornato annualmente in caso di modifiche e si può redigere anche solo in lingua inglese.

Calendario delle attività formative (D.PHD.2.1)
Training calendar

Indicare:

- *l'elenco dei corsi organizzati, specificando la durata in ore, i cfu, il SSD, l'anno e il docente (componenti del Collegio dei docenti, studiosi ed esperti italiani e stranieri di elevato profilo provenienti dal mondo accademico, dagli Enti di ricerca, dalle aziende, dalle istituzioni culturali e sociali)*
  the list of organized courses, specifying the duration in hours, credits, SSD, the year and teacher (members of the PhD Board, high-profile Italian and foreign scholars and experts from the Academia, research institutions, companies, cultural and social institutions)

The doctoral training program includes the following courses (Board members are indicated with *):

Proff. Diego Perugini*, Simonetta Cirilli*, Marco Cherin*, Massimiliano Barchi*, Carlo Cardellini*, Costanza Cambi*, Azzurra Zucchini*, Giorgio Minelli* (University of Perugia)
Earth System and Global Changes
Duration: 54 h
Credits: 9
Year: Mandatory course for students of the first (or second) year

Dr. Paolina Bongioannini Cerlini (University of Perugia)
Introduction to Atmospheric Physics, Climate and COPERNICUS DATA STORE (CDS)
Duration: 20 h
Credits: 3
Year: Students of all PhD years can attend the course

Prof. Maurizio Petrelli* (University of Perugia), Dr. Alessandro Mondini* (CNR-IMATI)
Machine learning for data analysis, and image classification in the Earth Sciences
Duration: 18 h
Credits: 3
Year: Students of all PhD years can attend the course

Dr. Maurizio Ercoli* (University of Perugia)
Ground Penetrating Radar in geosciences: principles and applications
Duration: 18 h
Credits: 3
Year: Students of all PhD years can attend the course

Dr. Andrea Sorci (University of Perugia)
Sedimentary petrology applied to reservoir characterization
Duration: 24 h
Credits: 4

Year: Students of all PhD years can attend the course

The courses are international, interdisciplinary, and multidisciplinary and do not attain at any specific Italian SSD. All courses have a final exam.

- *la presenza di una serie di seminari specifici del corso (numero annuo, cadenza temporale, cfu riconosciuti)*
  the presence of a series of specific seminars of the course (annual number, frequency, recognized credits)

The doctoral training program includes the following seminars (scheduled weekly in the first semester):

1. Marzia Breda (University of Padova) – Terrestrial mammals from the Ice Age: what do they tell about the Quaternary climate changes?
2. Giovanni Chiodini (INGV) - The hidden activity of Campi Flegrei: magma degassing events
3. Enrico Capezzuoli (University of Florence) - Non-marine carbonates: repository of palaeoenvironmental data and climate changes
4. Fabio Trippetta (Sapienza University of Rome) - From earthquakes to energy resources: the role of petrophysics in understanding geological processes
5. Irene Bollati (University of Milan) - Geoheritage and geodiversity: key concepts for understanding Earth System evolution
6. Antonio Langone (University of Pavia) - Dalla geocronologia alla petrocronologia: la brama del vincolo temporale nelle Geoscienze
7. Piero Gianolla (University of Ferrara) - Ricostruire il Tempo Profondo: riflessioni dal Triassico delle Dolomiti
8. Fátima Viveiros (IVAR-Universidade dos Açores) - CO2 diffuse degassing - a permanent hazard in volcanic areas

Students acquire 3 credits by attending at least 75% of the proposed seminars.

- *la presenza di altri eventi scientifici (numero annuo e cfu riconosciuti)*
  the presence of other scientific events (annual number and recognized credits)

The doctoral training program includes the following schools:

1. Scuola Pialli 2024 (3 credits)
2. School of Paleoanthropology 2024 (6 credits)
3. International Short Course on Application of Laser Ablation Inductively Coupled Plasma Mass Spectrometry to Earth Sciences (3 credits)
4. Vulcano Summer School (9 credits)

To complete their training (30 credits), PhD students can attend courses and schools offered by external national and international institutions, in agreement with the objectives of their training and research program and **following the guidelines on doctoral training/teaching programs of the University of Perugia.**

Integrazione dei dottorandi nella comunità scientifica (D.PHD.2.2)
Integration of PhD students in the scientific community

Indicare:

- *la presenza di momenti formativi di scambio/presentazione dei risultati della ricerca (numero e cadenza temporale)*
  the presence of training sessions for the exchange/presentation of research results (number and timing)

The PhD Board encourages and advertises students' participation in communication events, especially among peers (e.g., "PhD Day" Società Geologica Italiana; "Palaeontologist in Progress annual workshop" Società Paleontologica Italiana; BeGEO Scientists annual meeting; etc.).
Number and timing per PhD student: at least 1 event/Cycle.

- *la partecipazione a congressi e/o workshop nazionali e internazionali, anche in qualità di relatori (numero annuo per dottorando)*
  participation in national and international congresses and/or workshops, also as speakers (annual number per PhD student)

PhD students are strongly encouraged to participate in national and international congresses/workshops consistent with their research program.
Number and timing per PhD student: at least 3 conferences/Cycle.

- *la partecipazione a scuole di formazione nazionali e internazionali (numero annuo per dottorando)*
  participation in national and international training schools (annual number per PhD student)

PhD students can integrate their own training program by attending national and international training schools (see "other scientific events" in D.PHD.2.1), in agreement with their research program.
Number and timing per PhD student: at least 1 school/Cycle.

Autonomia del dottorando (D.PHD.2.3)
Autonomy of the PhD student

Indicare:
- *le attività organizzate per sviluppare l'autonomia del dottorando nel concepire, progettare, realizzare e divulgare programmi di ricerca e/o di innovazione*
  activities organized to develop the autonomy of the PhD student in conceiving, planning, implementing and disseminating research and/or innovation programs

The Board encourages the PhD students to attend the transversal courses (if any) organized by the University of Perugia to enhance their soft skills (e.g., Computer improvement; Management of research and knowledge of European and international research systems; Exploitation and dissemination of results, intellectual property and open access to data and research products).

- *la presenza di componenti del Collegio dei docenti, tutor esterni di caratura nazionale/internazionale e/o professionale che svolgono funzioni di supporto e guida*
  the presence of members of the teaching staff, external tutors of national/international and/or professional standing who perform support and guidance functions

A member of the Board (Prof. Laura Melelli) acts as tutor for the students performing support and guidance functions.

- *la presenza di un co-supervisore all'interno dell'impresa per i dottorati industriali*
  the presence of a co-supervisor within the company for industrial doctorates

The PhD in Earth System and Global Changes is not an industrial doctorate.

- *le modalità di individuazione del tutor e il numero massimo di dottorandi assegnati*
  the methods for identifying the tutor and the maximum number of doctoral students assigned

The tutor for each PhD student is identified and appointed by the Board on the basis of research affinities/background.
Each tutor can supervise a maximum of 3 students (exceptional cases where a higher number of students are requested to be supervised must be evaluated and authorized by the Board).

Risorse finanziarie e strutturali (D.PHD.2.4)
Financial and structural resources

Indicare:
- *le risorse fornite dall'Ateneo*
  the resources provided by the University

1 scholarship funded by the University
1 scholarship funded by the University (PRO3 – 2021/2023 project)
2 scholarships funded by PNRR funds (D.M. 118/2023)

- *le risorse fornite dal Dipartimento e/o dai supervisori*
  resources provided by the Department and/or supervisors

1 scholarship funded by the Department of Physics and Geology (Super-C project)

- *le strutture operative e scientifiche a disposizione dei dottorandi*
  the operational and scientific structures available to doctoral students

Equipment and/or Laboratories: Optical and Dielectric Spectroscopy; X-ray diffractometry and fluorescence; Dynamics of Complex Systems; Development of Radiation Detectors; Applied Geology and Geophysics, Hydrogeology, Photogeology and Cartography; Scanning Electron Microscopy; Space Test Laboratories (SERMS and CEM; Terni); Astrophysics/Astronomical Observatory; Fluid geochemistry; LA-ICP-MS microanalysis; high-T experimental volcanology; Rock sample preparation lab (thin sections, organic matter samples, incoherent rock samples, etc.); Vertebrate paleontology; 3D scanning (high-resolution structured-light 3D scanners; laser scanner; photogrammetry) and printing (high-resolution 3D printer) hardware and associated software.
Library heritage: At the Library of Mathematical, Physical and Geological Sciences, a vast range of volumes, reference texts, and scientific journals are available for PhD students, who also have access to the other University libraries and online databases.

<u>E-resources</u>: The major international databases of interest to the PhD disciplines are accessible online and available to PhD students. Software packages (both proprietary and open-source) are available for data analysis, simulations, and design in the research fields of interest to the PhD. Moreover, in the Department of Physics and Geology there is a computer center managed in collaboration with INFN and CNR local sections. Resources include a central GRID system of 256 CPUs and individual computers, as well as shared print and mass storage facilities.

<u>Other</u>: For technological support to research there are service laboratories, such as: Mechanical Workshop; Sample Preparation and Analysis; Chemical and Mineralogical Analysis; Electronics; Electron Microscopy; Geology and Applied Geophysics.

Attività didattiche e di tutoraggio (D.PHD.2.5)
Financial and structural resources

Indicare:
- *le attività di didattica e/o tutoraggio coerenti con il progetto di ricerca consentite ad ogni dottorando (numero massimo di ore annue)*
  the teaching and/or tutoring activities consistent with the research project allowed to each PhD student (maximum number of hours per year)

Each PhD student can carry out a maximum of **40 hours/year** for teaching and/or tutoring activities consistent with his/her research project.

Relazioni scientifiche e mobilità dei dottorandi (D.PHD.2.6)
Scientific reports and PhD student mobility

Indicare:
- *la presenza di cotutele e/o il rilascio di titoli multipli*
  the presence of co-tutorships and/or the issue of multiple titles

None

- *la durata di periodi di mobilità obbligatoria dei dottorandi presso qualificate Istituzioni accademiche e/o industriali o presso Enti di ricerca pubblici o privati, italiani o esteri*
  the duration of periods of mandatory mobility of PhD students at qualified academic and/or industrial institutions or at public or private, Italian or foreign research institutions

The minimum period of stay in qualified foreign institutions depends on the scholarship awarded:
University scholarship PRO3 2021-2023: **6 months.**
PNRR scholarships: **6 months.**
University/Department scholarships: **6 months (recommended, not mandatory).**

Prodotti della ricerca (D.PHD.2.7)
Research products

Indicare:

- *la tipologia e il numero dei prodotti della ricerca attesi per ogni dottorando (pubblicazioni su riviste, pubblicazione della tesi, deposito di brevetti, sviluppo di strumenti o software, etc...)*
  the kind and number of research products expected for each PhD student (publications in journals, publication of the thesis, filing of patents, development of tools or software, etc...)

By the end of the Cycle, each student is required to have **at least 2 papers** accepted in peer-reviewed indexed journals, concerning topics consistent with his/her research project.