



D.2.2 – Good practices report

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1. Introduction & Goals

The UniSchoolLabS Toolkit will be validated by ten (10) schools which will provide UniSchoolLabS partners with feedback on the quality, feasibility and accessibility of the project.

The purpose of this document is to perform the in-depth analysis of the selected GPs. Based on the publicly information available and the information provided by the GPs creators, an individual template has been completed for each GP. The template (to be seen on Section “2. Template for GPs in-depth analysis”) focuses on the pedagogical scenarios, organizational settings, human & technical infrastructure plus the usability issues related to each GP.

2. Template for GPs in-depth analysis

Before proceeding to the composition of the UniSchoolLabS toolkit, a deeper analysis of the selected GPs needed to be carried out. After consulting the other partners and collecting a number of suggestions and comments, EUN composed the following template which has been applied and filled in for all GPs. Further information gathering and contact to the GPs’ creators, had to be taken before a full profile of the all GPs could be composed.

General information

- a) Basic information on the GP with a general description
- b) GP URL
- c) Subjects (Subjects covered by the GP): Physics, Chemistry, Science, Maths, Biology, Informatics, Astronomy
- d) Author (Creator of the GP)
- e) Languages (Current language of the GP)

Laboratory used:

Type of Education (Primary or Secondary)

Users’ access (free, guest, login needed)

In-depth description of the laboratory (procedure)

Activities related to the laboratory (if any)

Learning materials needed in order to carry out the GP (remote or virtual)

Background knowledge needed

Type of experiment (individual or cluster of many experiments)

Experiment plans available (if any)

Feedback mechanisms in order to collect information from users

Validation experience (number/types of schools/students)

3. GPs in-depth analysis

In this section we provide the information collected for each of the GPs.

3.1. The Planets and their characteristics

General information

- a) Basic information on the GP with a general description: *A Pedagogical scenario about the characteristics of the planets. The scenario can be expanded and adapted by the user using the resources of the Discovery Space network of telescopes <http://www.discoveryspace.net/>*
- b) GP URL: <http://www.cosmosportal.eu/cosmos/en/node/16895>
- c) Subjects (Subjects covered by the GP): *Astronomy*
- d) Author (Creator of the GP): <http://www.cosmosportal.eu>. *This project is funded under the eContentplus programme, a multiannual Community programme to make content in Europe more accessible, usable and exploitable*
- e) Languages (Current language of the GP): *English, German, Russian, Finnish, French, Greek, Swedish, Turkish*

Laboratory used: *DSpace*

Type of Education (Primary or Secondary): *Primary, Secondary*

Users' access (free, guest, login needed): *Free. It can be used under a guest or user status. To be a user, registration and login are needed (very straight forward).*

Type of Education (Primary or Secondary): *Both*

In-depth description of the laboratory:

Educational phase 1: Concept Exploration –Exploration:

Collect data and information about the planets, especially:

- their diameters
- their masses

- the characteristics of their surface (rocky/liquid: crater, tectonic plates, oceans; gaseous: atmosphere, clouds)

Information can be collected with the help of

- moCo (mobile Cosmos)
- the presentation<< Planeten unseres Sonnensystems.pdf >> (in German)

Educational Phase 2: Concept Introduction

- Determine the volume of the individual planets and compare them with the Earth's volume

$$V = 4\pi/3 R^3$$

- Determine the middle density of the individual planets, compare them with the Earth's one and try to conclude on the internal structure of each Planet

$$M = \rho V \quad \Rightarrow \quad \rho = M / V$$

Educational Phase 3: Concept Application

- **Generalization of the concept:**
 - Detailed findings of space probe flights
 - Orbits and classification into different types of planets (Earth like planets, gas giants, inner/outer planets)
 - Definition of a planet: old/new (since 2006)

Educational Phase 4: Concept Exploration –Observation:

Observe the planets with a telescope

- Venus (phases, atmosphere)
- Mars (polar caps, volcanoes, canyon)
- Jupiter (cloud structures, Great Red Spot, moons)
- Saturn (atmosphere, ring system)

Learning materials needed in order to carry out the GP (remote or virtual): *Students need to have access to a normal telescope in order to observe the planets. Internet access is also needed*

to facilitate their research into the different planets and their characteristics. Access to MoCo (Mobile cosmos) and an informational pdf file provided with the educational material is also helpful.

Background knowledge needed: *Not really needed since all information is provided at the beginning of each phase.*

Type of experiment (individual or cluster of many experiments): *Cluster of many experiments starting from viewing the planets to researching their morphological details and determining their volume.*

Experiment plans available (if any): *Teaching material is available here: http://www.cosmosportal.eu/cosmos/files/uploads/objects/PLE_LCY_IMS_EN.zip (for registered users only)*

Feedback mechanisms in order to collect information from users: *Registered users can submit feedback for the portal (Co-Design COSMOS)*

Validation experience (number/types of schools/students): *Students from 6 years old and onwards have extensively made use of this laboratory.*

3.2. Observations of the Galaxy

General information

- a) Basic information on the GP with a general description: *To form skills and knowledge for the conduction of astronomical observations about our Galaxy.*
- b) GP URL: <http://www.cosmosportal.eu/cosmos/en/node/55933>
- c) Subjects (Subjects covered by the GP): *Astronomy*
- d) Author (Creator of the GP): <http://www.cosmosportal.eu>
- e) Languages (Current language of the GP): *Bulgarian, English, Finnish, German, Greek, Swedish*

Laboratory used: *DSpace*

Type of Education (Primary or Secondary): *Both*

Users' access (free, guest, login needed): *Free. It can be under guest or user status. To be a user, registration and login are needed (very straight forward).*

In-depth description of the laboratory: *It is formed by a group of internet files divided in exercises for the students to carry out, with an introduction and then an activity in each one:*

- *Concept Introduction: Organization and preparation for observations of the galaxy and conduction of the observations.*
- *Concept Exploration: Students observe and study constellations of the Milky Way.*
- *Concept Application – Generalization of the concept: Students apply the guidelines of the teacher and observe the constellations and the Milky Way.*
- *Concept Exploration – Observation:*

Activities related to the laboratory (if any): *Each file comes with a set of special activities that students need to carry out e.g.:*

- *Visual observations with binoculars and a school telescope*
- *Draw the Milky Way on the sky map*
- *Discuss question regarding the star population*
- *Find the constellations through which the Milky Way passes*
- *Determine the orientation of the Milky Way*

Learning materials needed in order to carry out the GP (remote or virtual): *No learning materials needed as long as teachers go through the background knowledge needed with the whole classroom. (see below)*

Background knowledge needed: *Basic understanding of the following concepts is needed:*

- *Milky way*
- *Sky map*
- *Constellations*
- *Telescopes & binoculars*

Type of experiment (individual or cluster of many experiments): *Individual experiment to be carried out either by individuals or by groups of students.*

Experiment plans available (if any): *Yes, within the files.*

Feedback mechanisms in order to collect information from users: *There is no directly feedback mechanism, but if you are a user of the COSMOS portal in order to download the activity, you can contact directly the creator of the activity through private messaging.*

Validation experience (number/types of schools/students): *No information available*

3.3. Conservation of Momentum

General information

- a) *Basic information on the GP with a general description: Using the Hypatia tool (<http://hypatia.phys.uoa.gr/>) students will determine the total momentum from all particles tracked after a particle collision in ATLAS CERN and will calculate (magnitude & direction) the missing momentum by applying two different methods of adding vectors.*
- b) *GP URL: <http://www.learningwithatlas-portal.eu/en/node/93575>*
- c) *Subjects (Subjects covered by the GP): Physics*
- d) *Author (Creator of the GP): Ellinogermaniki Agogi*
- e) *Languages (Current language of the GP): English, Greek, Finnish, French, German, Swedish*

Laboratory used: *Hypatia*

Type of Education (Primary or Secondary): Secondary

Users' access (free, guest, login needed): *Only registered users can have access to the educational material. Registration is free and simple to perform.*

In-depth description of the laboratory: *All information can be found in: http://www.learningwithatlas-portal.eu/files/uploads/objects/100219_Conservation_of_Momentum_in_Particle_Collisions.pdf (accessible to registered users only)*

Activities related to the laboratory (if any):

- *Questionnaire on eliciting activities*
- *Planning and conduction of active investigation on measuring, adding and conserving vectors (with the use of the Hypatia tool)*

Learning materials needed in order to carry out the GP (remote or virtual): *Internet connection for downloading the Hypatia tool. All versions available for download can be found here: <http://hypatia.phys.uoa.gr/Downloads/>. For high school students a simpler version of HYPATIA is available (called Simplified HYPATIA sv).*

Background knowledge needed: *Students need to have an understanding of mass, velocity, acceleration, force and energy, and the way Newton's laws tie them together. Students should also know the difference between scalars & vectors: Vector quantities have two characteristics, a magnitude and a direction. Scalar quantities have only a magnitude. When doing any mathematical operation on a vector quantity (like adding, subtracting, multiplying) you have to consider both the magnitude and the direction.*

Before starting, the students should also become familiar with the background information and the ATLAS detector given in the "[Read about](#)" section. They should also read the material given in "[Basics](#)" (or "Simplified Basics" according to the version used) in order to get familiar with the aims of the analysis tools and the physics quantities which they will measure.

Finally, in order to learn about the different windows of the HYPATIA project, they should read the how to "[Use HYPATIA](#)" (or how to "[Use Simplified Version](#)" which is aimed to high school students).

Type of experiment (individual or cluster of many experiments): *Individual experiment that can be carried out either by an individual or a group of students.*

Experiment plans available (if any): *Not specified*

Feedback mechanisms in order to collect information from users: *A mailing list connected to the team working on the project is available for users to use in order to report problems or ask for help. Other feedback mechanisms are not available.*

Validation experience (number/types of schools/students): *No information is available*

3.4. Remote Laboratories

General information

a) *Basic information on the GP with a general description: A selection of Physics and Engineering targeted experiments. The objective of this project was to build a set of experiments and to establish a user-friendly and efficient technology for interactive, on-line operation of a prototype remote education laboratory at the Universidade do Porto.*

This particular project also proved how people from science and engineering areas were able to produce together a diverse set of experiments, ranging from interactive to sensitive type, either inside educational labs or in a real life environment, as in the case of a sensorized stone masonry bridge.

b) *GP URL: <http://remotelabsup.fe.up.pt/experiments.htm>*

c) *Subjects (Subjects covered by the GP): Physics*

d) *Author (Creator of the GP): Instituto de Recursos e Iniciativas Comuns da Universidade do Porto*

e) *Languages (Current language of the GP): English*

Laboratory used: *Remote Laboratories @ up*

Type of Education (Primary or Secondary): *Secondary*

Users' access (free, guest, login needed): Users can use their Moodle account or login with as guest in order to use each experiment. To perform the remote experiments, users need to use Internet Explorer (version 6 and later) and install a plugin for labVIEW 7.1. If they do not have this plugin they can download it and install it from a link provided in the website.

In-depth description of the laboratory: In-depth description of each laboratory is available at the following URLs:

1. Mechanical material characterization: <http://foton.fe.up.pt/moodle/course/view.php?id=3>
2. Level measurement and control:
<http://foton.fe.up.pt/moodle/course/view.php?id=4>
3. Temperature measurement and control:
<http://foton.fe.up.pt/moodle/course/view.php?id=5>
4. Monitoring of a stone masonry bridge: <http://foton.fe.up.pt/moodle/course/view.php?id=6>
5. Force calibration procedure:
<http://foton.fe.up.pt/moodle/course/view.php?id=8>
6. Coupled oscillators:
<http://foton.fe.up.pt/moodle/course/view.php?id=7>
7. Buoyancy measurement:
<http://foton.fe.up.pt/moodle/course/view.php?id=2>

Activities related to the laboratory (if any): To perform the experiments list above users can access freely the provided Moodle platform. A list of participants that have done the experiment is also available for every experiment. In the "Activities" sections the following functions are provided:

- Bookings (with a calendar to book for the experiment)
- Forums (for the users to interact with each other)
- Resources (with two files: a description of the experiment and how to perform the experiment)

Learning materials needed in order to carry out the GP (remote or virtual): In order to perform this remote experiment, you'll need to have LabVIEW 7.1 or LabVIEW 7.1 Run-Time (<ftp://ftp.ni.com/support/labview/runtime/windows/7.1/LVRunTimeEng.exe>)

Background knowledge needed: A detailed description of the experiment and the knowledge related to it is being provided for each experiment under "Experiment description" in the Moodle course(s).

Type of experiment (individual or cluster of many experiments): *Cluster of various Physics experiments*

Experiment plans available (if any): *Detailed description of each experiment can be found in the Moodle course(s).*

Feedback mechanisms in order to collect information from users: *There is no clear feedback mechanism, but there is a forum and contact details of the organiser of the experiments. For each experiment there is also a Reporting facility where users answer a specific answer, submit it and if there are registered they will receive some feedback from the course instructor.*

Validation experience (number/types of schools/students): *Not available*

3.5. The Discovery Space project

General information

- a) *Basic information on the GP with a general description:*
- b) *GP URL: http://www.discoveryspace.net/index.asp?Cat_id=584*
- c) *Subjects (Subjects covered by the GP): Astronomy*
- d) *Author (Creator of the GP): OTE S.A*
- e) *Languages (Current language of the GP): English*

Laboratory used: *DSpace*

Type of Education (Primary or Secondary): *Primary, Secondary*

Users' access (free, guest, login needed): *Registration is needed and is free of charge. There are two (2) different statuses available but for most users, Full member is the most appropriate choice.*

In-depth description of the laboratory: *The Discovery Space project contributes to the access to and sharing of advanced tools, services and learning resource not only among schools but also among science parks and research centres. The project aims at the deployment of a virtual science thematic park that will connect schools, universities, science museums and parks with a network of robotic telescopes around the world. The project is building on this aim as it brings to students, teachers, researchers and individuals (amateur astronomers, visitors of science parks) all around the world the opportunity to use remotely controlled robotic telescopes in real time giving accessibility to unique resources as the sky is a vast and unique laboratory of science, always in operation, accessible at all times to everybody from everywhere, where all sorts of interesting physical phenomena take place most of which is impossible to reproduce in any*

scientific laboratory. Finally it supports the provision of key skills to the future citizens and scientists (collaborative work, creativity, adaptability).

Learning materials needed in order to carry out the GP (remote or virtual): *For the actual observation users have the following options:*

- *Submit their observational requests in four steps: Select a telescope, select an astronomical object, check the weather and fill in the details like date, filters, duration, etc.*
- *Users can operate Skinakas telescope in real time by giving the coordinates of the object they wish to shoot, and the telescope immediately starts moving to fulfil their request. To become an authorized user they need to [download and fill-in the application form](#) and then send their CV and application form to the [Scientific Committee](#) of D-Space. If you are selected, the Scientific Committee will contact you in order to give you the username and password for a specific date.*

Consequently users need:

- *Pc with internet access*
- *Basic understanding of the following concepts: telescope, coordinates, measurements, telescope filters etc*

Background knowledge needed: *For every scenario a “General information” section describing the tools, materials and basic vocabulary needed is provided.*

Type of experiment (individual or cluster of many experiments): *Individual experiment that allows users to provide coordinates to a real telescope and move it in real time.*

Experiment plans available (if any): *No available information*

Feedback mechanisms in order to collect information from users: *A forum (<http://www.discoveryspace.net/forum/default1.asp->) is available for users to raise their questions and exchange experiences. The development team can also be contacted in this email: dspace@ea.gr*

Validation experience (number/types of schools/students): *No available information*

3.6. The Virtual Chemistry Laboratory

General information

- a) *Basic information on the GP with a general description:*
- b) *GP URL:* <http://www.chemcollective.org/instructors.php>
- c) *Subjects (Subjects covered by the GP):* Chemistry
- d) *Author (Creator of the GP):* The project leader is Dr. David Yaron, Associate Professor of Chemistry at Carnegie Mellon. Many of the original activities on this site were developed by a group at Carnegie Mellon, including Yaron, experienced software engineers, undergraduate programmers, educational consultants, and technical writers. Many Virtual Lab activities were also designed by contributors from other universities, including a number from Robert Belford.
- e) *Languages (Current language of the GP):* Most of the activities are available in English while French and Spanish are also in the pipeline for the near future.

Laboratory used: ChemCollective

Type of Education (Primary or Secondary): Secondary

Users' access (free, guest, login needed): Free, no registration is needed.

In-depth description of the laboratory: A list of all available activities can be found here: <http://www.chemcollective.org/find.php>

Learning materials needed in order to carry out the GP (remote or virtual): Users need to have access to a computer that is running Microsoft windows or Macintosh OS 10.1 or higher. They also need to have the appropriate rights in order to download, install and run the laboratory in their computer.

Background knowledge needed: Students should be familiar with one or more of the following concepts:

- molarity
- dilution
- thermochemistry
- limiting reagents
- scientific method
- solubility
- stoichiometry
- pKa
- equilibrium

- *density*
- *acids and bases*
- *oxidation/reduction*

Type of experiment (individual or cluster of many experiments): *Cluster of Chemistry experiments on a variety of subjects*

Experiment plans available (if any): *As a project in the [National Science Digital Library \(NSDL\)](#), the ChemCollective's goals are to support a community of instructors interested in improving chemistry education through interactive and engaging online activities. They invite Instructors to use the materials and to contribute by providing comments and feedback on the activities, sharing classroom experiences, and participating in discussions. Instructors are especially encouraged to modify or create activities with the authoring tools for Virtual Labs and scenarios that are provided.*

Feedback mechanisms in order to collect information from users: *According to the website The Chemistry Collective project is currently funded by the National Science Foundation, so the software is available free of charge to all educators and students. Educators and their students can use it on the web immediately without any licensing requirements. They are only asked to let the National Science Foundation know that they are using it, along with the number of students involved, so that they can report data about the overall use to their funders. Additional comments are also welcome to help improve all of the activities in that collection.*

Validation experience (number/types of schools/students): *The activities on the ChemCollective are used by thousands of students each month. More information was requested on 9/4 but no answer has been received so far.*

3.7. Introduction to Elementary particles

General information

- a) Basic information on the GP with a general description: *Introduction to elementary particles using the tools of ATLAS*
- b) GP URL: <http://www.learningwithatlas-portal.eu/en/node/93606>
- c) Subjects (Subjects covered by the GP): *Physics*
- d) Author (Creator of the GP): *Ellinogermaniki Agogi*
- e) Languages (Current language of the GP): *English, Greek*

Laboratory used: *Hypatia*

Type of Education (Primary or Secondary): *Secondary*

Users' access (free, guest, login needed): Simple registration to Atlas is needed

In-depth description of the laboratory:

The teacher talks about detectors and introduces the HYPATIA software.

The teacher explains to the students the exercises that will take place:

They will be given a series of tracks (pre-selected by the teacher) from various events and try to identify them

Students:

- *Are divided into groups of two or three*

- *Perform the experiment*

*a) Identify the tracks from various events**

b) Download specific events

(the event files are pre-selected by the teacher, e.g. file JiveXML_5104_20655.xml with 5 tracks overall)*

a) Use the software to identify the tracks and compare them to their knowledge (detector's zones etc)

b) Examine if the beam geometry (direction in space) can affect the particle identification process

**The pre-selected tracks chosen are those where the particles tracks (when seen on the side view) are perpendicular to the PC screen*

Learning materials needed in order to carry out the GP (remote or virtual): *PC(s) that run Hypatia software*

Background knowledge needed: *All needed terms and concepts are clearly described in the provided educational material: http://www.learningwithatlas-portal.eu/files/uploads/objects/Intro_to_Elementary_Particles.ppt*

Type of experiment (individual or cluster of many experiments): *Individual experiment*

Experiment plans available (if any): *No information available*

Feedback mechanisms in order to collect information from users: *No information available*

Validation experience (number/types of schools/students): *No information available*

3.8. NetLab

General information

- a) Basic information on the GP with a general description: *NetLab is an online remote laboratory, which is used by academic staff for teaching and demonstrations during lectures, and by students for conducting their experiments remotely on real laboratory equipment.*

The application presents users with graphical user interfaces (GUIs) that look like actual laboratory instruments. They click the buttons and turn the knobs with their mouse, interacting with it as they would with the real device.

What makes NetLab unique is that when students interact with the GUIs, they are actually operating real instruments that are set up in a laboratory in some remote location, controlling them via the internet. The output they see on the instrument's display panels is not a simulation, but is actual data being read from the real instruments, in real time.

- b) GP URL: <http://netlab.unisa.edu.au/index.xhtml/>
- c) Subjects (Subjects covered by the GP): *Physics*
- d) Author (Creator of the GP): *School of Electrical of Information Engineering in the Division of Information Technology, Engineering and the Environment, University of South Australia*
- e) Languages (Current language of the GP): *English*

Laboratory used: *NetLab*

Type of Education (Primary or Secondary): *Secondary*

Users' access (free, guest, login needed): *Free access but basic registration with a valid email address is needed.*

In-depth description of the laboratory: *Detailed instruction sheets for each of the NetLab experiments are available here: <http://netlab.unisa.edu.au/experiments.xhtml>*

Additional information on how to use The Netlab Remote Laboratory is provided in every detail here: <http://netlab.unisa.edu.au/guide/guide.xhtml>

Activities related to the laboratory (if any): *No additional activities are described*

Learning materials needed in order to carry out the GP (remote or virtual): *PC with internet access and account for Netlab.*

Background knowledge needed: *Basic concepts of*

- *AC Circuits*

- *RC Circuits*
- *RC filters*
- *Phasor diagrams*

Type of experiment (individual or cluster of many experiments): *Cluster of electrical engineering experiments*

Experiment plans available (if any): *No information available*

Feedback mechanisms in order to collect information from users: *No information available*

Validation experience (number/types of schools/students): *No information available*

3.9. Remote Farm

General information

a) Basic information on the GP with a general description: *Remote-experiments are real-life settings with all devices (like power supplies, voltmeters, stepping motors) connected to a PC. The computers work as web servers at the same time, so everybody can get access to the experiments through a browser plug-in and gain control over all devices. All data recorded during the experiment is stored online under your own account and accessible via this website under "measured data".*

b) GP URL: <http://remote.physik.tu-berlin.de/farm/index.php?id=1&L=1>

c) Subjects (Subjects covered by the GP): *Physics*

d) Author (Creator of the GP): *Berlin Institute of Technology*

e) Languages (Current language of the GP): *English, German, Russian*

Laboratory used: *Remote Farm*

Type of Education (Primary or Secondary): *Secondary*

Users' access (free, guest, login needed): *A basic (but free) registration is needed. Users also need to download specific software (more details are given below).*

In-depth description of the laboratory: *Detailed descriptions of all remote experiments can be found here: <http://remote.physik.tu-berlin.de/farm/index.php?id=3&L=1>*

Activities related to the laboratory (if any): *No additional activities are described*

Learning materials needed in order to carry out the GP (remote or virtual): *Computer with a Web browser (preferably Internet Explorer v.5 and later). The experiments are controlled with LabView 8.0. To carry out and control an experiment you have to install the LabView 8.0 run-time engine (RTE) (see [Installation](#)). Afterwards, the panel ("virtual instrument"=VI) for the experiment opens up within your browser window.*

Background knowledge needed: *Some understanding of the following concepts is needed:*

- *Circuits*
- *Transient analysis*
- *Transient time*
- *Equilibrium state*
- *Phasor analysis*
- *Filters*

Type of experiment (individual or cluster of many experiments): *Cluster of experiments on Classic and Modern Physics.*

Experiment plans available (if any): *No information available*

Feedback mechanisms in order to collect information from users: *All data recorded during the experiment is stored online under users' accounts and is made accessible via the website and under "measured data".*

Validation experience (number/types of schools/students): *No information available*

3.10. Planet Impact

General information

- a) Basic information on the GP with a general description: *Provides the possibility to discover the fierce force of gravity and pelt Jupiter with a comet!*
- b) GP URL: <http://amazing-space.stsci.edu/resources/explorations/impact/>
- c) Subjects (Subjects covered by the GP): *Physics, Astronomy*
- d) Author (Creator of the GP): *Formal Education Group of the Space Telescope Science Institute's Office of Public Outreach - STScI, USA*
- e) Languages (Current language of the GP): *English*

Laboratory used: *DSpace*

Type of Education (Primary or Secondary): *Primary, Secondary*

Users' access (free, guest, login needed): *Free access, no log-in is required*

In-depth description of the laboratory: <http://amazing-space.stsci.edu/resources/explorations/impact/teacher/lessonplan.html#procedure>

Activities related to the laboratory (if any):

1. "Target Practice" Analysis

Description:

Students collect "hit", "miss," and "breakup" information about their comets as they complete the lesson. Then they use the information to draw a graph of angle versus speed. The graph will help them determine the combinations of angle and speed that are needed to either hit or miss the planet.

Materials:

A chart is needed that is similar to the one shown here. Show the students how to set it up (explanation below):

Angle	Speed	Result
<i>0 degrees</i>	<i>All</i>	<i>Hit</i>
<i>30 degrees</i>	<i>Skateboard & Bicycle</i>	<i>Hit</i>
	<i>Car</i>	<i>Broke Up</i>
	<i>Rocket</i>	<i>Miss</i>
<i>60 degrees</i>	<i>Skateboard</i>	<i>Hit</i>
	<i>Bicycle</i>	<i>Broke Up</i>
	<i>Car & Rocket</i>	<i>Miss</i>
<i>90 degrees</i>	<i>Skateboard</i>	<i>Broke Up</i>

the (vertical) y-axis, which is labeled from 0 to 90 degrees; the speed is plotted on the (horizontal) x-axis. Your teacher will help you put a scale on the speed axis using the four vehicles' relative speeds. Plot the angle and speed for each breakup point. Draw a smooth line through these points, and make the line asymptotically meet the x-axis. Explain why there is an asymptote on the x-axis. Once your line is drawn, label the two sections of the graph the "hit" and "miss" zones.

2. Boy that was Some Comet!

Description:

Following the inquiry-based engagement activity (listed above as the first suggested engagement activity), students read "Comet News" to find the answers to as many of their questions as possible.

Materials:

Copies of or access to the first seven articles listed in the "Comet News" table of contents, reached from the "Comet News" button on the home page. (The eighth article is about comet LINEAR). Students can read the articles from the computer screen, or teachers can provide printed copies of the articles from the PDF file found in the Grab Bag section of this document (Comet News – seven articles, [PDF 4.4MB](#); Comet LINEAR article, [PDF 200Kb](#)). More information about comet LINEAR is available at: <http://opposite.stsci.edu/pubinfo/pr/2000/27/faq.html>

Instructions to the Teacher:

A logical extension of the inquiry-based engagement activity is to ask students to read the story of the discovery of comet Shoemaker-Levy 9 and its crash into Jupiter. Direct the students to find answers to their questions by reading the seven articles on the comet.

If they don't find their answers in "Comet News," send them to the sections on "Gravity Gallery" and "Science Background," or to one of several websites devoted to the comet's crash listed in the Grab Bag section of this document. A link to "Gravity Gallery" is located on each section of the lesson. The gallery contains images of Jupiter and the comet.

Another activity is to ask students to read the eighth article on the breakup of comet LINEAR. Then students can make a graphic organizer (T-chart or Venn diagram) that lists the similarities and differences between the two comets, which are listed below:

Comet Shoemaker-Levy 9	Comet LINEAR
<i>Pulled apart by Jupiter's gravity</i>	<i>Sun's heat caused the pieces to come apart</i>

<i>Discovered after it fell apart</i>	<i>Scientists watched it fall apart</i>
<i>Impacted Jupiter</i>	<i>Just disappeared (implied)</i>
<i>Came from either the Kuiper Belt or the Oort Cloud</i>	<i>Came from the Oort Cloud</i>
<i>First to be viewed impacting a planet</i>	<i>Most recently viewed falling apart in inner solar system.</i>

Instructions to the Student:

Write down the answers to your questions by reading the first seven articles from "Comet News." Your teacher may give you the articles. If printed copies aren't provided, use the "Comet News" button on the home page of "Planet Impact!" to get to a list of links to all the articles. If you don't find the answers in "Comet News," try the "Gravity Gallery" section, or the "Science Background" section, or click on some of the websites about the comet located in the Grab Bag section of the Teacher Pages. Your teacher will help you find them.

Read the eighth article about comet LINEAR. Make a list of qualities and characteristics that the comets Shoemaker-Levy 9 and LINEAR have in common and those that are unique to each comet. Arrange them in a graphic organizer such as a T-chart or Venn diagram. Then write a paragraph about what you observed.

3. Gravity Challenge

Description:

Students search HubbleSite's "News and Views" for examples of astronomical changes governed by gravity. The objective: finding the most articles.

Materials:

- *Access to the Internet for groups of two to three students*
- *HubbleSite's "News and Views" (http://hubblesite.org/news_and_views/) bookmarked on the computers*

Instructions to the Teacher:

Tell students to click on "News & Views" from the HubbleSite top page. Once there, they should search the archives, arranged by year and subject, for examples of astronomical changes governed by gravity. These could be text or images as long as students can explain how gravity

works. You can ask students to find as many examples as possible during an allotted time period. Then play an elimination game. The winners would be given a gravity-appropriate prize such as a ride in an elevator or no homework (they don't have to lift their textbooks). To play the game, a group would present the title of a press release and explain the influence of gravity on the celestial object in the release. Other groups that had selected the same press release would have to cross it off their list. Then another group would share one of their findings. Each group would present an example until there were no new ones left. An example of what the student might find is the press release: "He2-90's Appearance Deceives Astronomers," which explains how two stars are interacting gravitationally. http://hubblesite.org/news_and_views/pr.cgi?2000+24 If you make this a two-day event, consider collecting students' lists at the end of the first day. The first day could be spent in the computer lab looking for examples and the second in the classroom discussing those examples. Collecting the lists ensures that they will be available on the second day (the one holding the list overnight might be absent the next day). It also prevents students with home Internet access from "padding" their lists overnight.

Instructions to the Student:

Use the website bookmarked by your teacher to search for examples of changes in celestial objects that were or are brought about by gravity. Write down the title of each press release and how gravity influences the astronomical object described in the release. Find as many as you can in the time allotted to you. The more you find, the better your chances of being the winner. Once time has expired, you will be asked to share one title and describe how that press release explains gravity's influence. Other students who have selected the same press release must cross it off their lists. The group with the most examples remaining after all have been shared is the winner and will receive an appropriate reward.

Teachers can use other disciplines to broaden their students' understanding of the force of gravity.

Art: Students can draw pictures of a comet slamming into Jupiter, creating plumes and flying debris. Images from the "Gravity Gallery" may help inspire the students to draw an artist's rendition of the impacts.

English: Students can write comet poems and stories. Perhaps they can research comet Shoemaker-Levy 9 or other remarkable comets, and write a newspaper article or a biography of one of the three discoverers of Shoemaker-Levy.

General Science: Students can expand their knowledge of gravity by studying microgravity. Information on this topic can be found in the microgravity teacher's guide, a PDF file: <http://spacelink.nasa.gov/Instructional.Materials/Curriculum.Support/Physical.Science/Microgravity/Microgravity/>

Biology: Students can draw and write about the kind of life that may have been brought to Earth from impacting comets and/or the effect that a large comet or asteroid impact might have on the existing life on Earth. Theories on the formation of the earth and moon due to impacts by other bodies (<http://zebu.uoregon.edu/1996/ph123/l11.html>) may start students on the right track.

Math: Students can read the NASA news brief "Microgravity – Fall into Mathematics," a PDF file that contains three "try this" math problems for students. <http://spacelink.nasa.gov/Instructional.Materials/NASA.Educational.Products/Microgravity-Fall.Into.Mathematics/> A teachers' guide to the mathematics of microgravity also is available. <http://spacelink.nasa.gov/Instructional.Materials/NASA.Educational.Products/Mathematics.of.Microgravity/>

Learning materials needed in order to carry out the GP (remote or virtual): *All learning materials needed are described under: <http://amazing-space.stsci.edu/resources/explorations/impact/teacher/grabbaq.html>*

Background knowledge needed:

Before attempting to complete this lesson, the student should:

- *Understand that the solar system consists of planets, moons, asteroids, meteoroids, comets, and the Sun.*
- *Understand that objects have mass.*
- *Know the relative masses of solar system objects.*
- *Understand that all objects are attracted to other objects by the force of gravity.*
- *Understand that an unbalanced force causes changes in an object's speed and/or direction.*

All background knowledge needed is clearly explained here: <http://amazing-space.stsci.edu/resources/explorations/impact/teacher/scientificbackground.html>

Type of experiment (individual or cluster of many experiments): *Cluster of different experiments.*

Experiment plans available (if any): *Not available information*

Feedback mechanisms in order to collect information from users: *None available*

Validation experience (number/types of schools/students): *Not available information*

3.11. World Pendulum

General information

- a) Basic information on the GP with a general description: *Five World Pendulums are currently positioned at different locations of the northern hemisphere. Each pendulum can be called up by a specific link (name of location) and be operated separately.*
- b) GP URL: <http://rcl.physik.uni-kl.de/worldpendulum/eng/index.htm>

- c) Subjects (Subjects covered by the GP): *Physics*
- d) Author (Creator of the GP): *S Gröber, M Vetter, B Eckert and H-J Jodl*
- e) Languages (Current language of the GP): *English, German*

Laboratory used: *Remotely Controlled Laboratories (RCL)*

Type of Education (Primary or Secondary): *Secondary*

Users' access (free, guest, login needed): *Free though some basic information (name, surname, email) needs to be provided before being able to run the experiments.*

In-depth description of the laboratory: *The setup and measurements to be taken are described here: <http://rcl.physik.uni-kl.de/worldpendulum/eng/index.htm>*

Activities related to the laboratory (if any): *Covered here: <http://rcl.physik.uni-kl.de/worldpendulum/eng/index.htm>*

Learning materials needed in order to carry out the GP (remote or virtual):

- a) *Teaching units [Breitengradabhängigkeit von g - RCL "Weltpendel"](#) on Lehrer Online (in German)*
- b) *[Collection of Problems about RCL "World Pendulum"](#)*
- c) *Calculation of the sphere radius for proper dimensions of the pendulum ([zip/Mupad-Datei](#))*
- d) *Data and parameter of pendula at the locations Aden, Riga, Napoli, Hermannsburg und Kaisersesch; in addition an automatic analysis of measured data ([zip/Excel-Datei](#))*
- e) *Modelling of the World pendulum: Dependency of the Earths acceleration on latitude $g(\varphi)$ in all pendulum models ([zip/Coach 5-Datei](#))* f) *[Tutorial to built ones own RCL "World pendulum"](#) (in German)*

Background knowledge needed: *Basic knowledge needed is explained here: <http://rcl.physik.uni-kl.de/worldpendulum/eng/index.htm> (under Theory)*

Type of experiment (individual or cluster of many experiments): *Individual experiment that can take place using a variety of pendulums in different locations.*

Experiment plans available (if any): *No available information*

Feedback mechanisms in order to collect information from users: *System collects Name, Country and Email for statistical purposes.*

Validation experience (number/types of schools/students): *No available information*

3.12. Observing with NASA

General information

- a) Basic information on the GP with a general description: *NASA's space science researchers control some of the world's most sophisticated space probes and orbiting telescopes to get amazing images of objects in space. Users can join them by operating their own ground-based "MicroObservatories" - real robotic telescopes that they can command through the website!*
- b) GP URL: <http://mo-www.harvard.edu/OWN/>
- c) Subjects (Subjects covered by the GP): *Astronomy*
- d) Author (Creator of the GP): *The project is funded by the NASA Science Mission Directorate, and managed by the Science Education Department at the Harvard-Smithsonian Center for Astrophysics. The Space Telescope Science Institute serves as Educational Partner to the project.*
- e) Languages (Current language of the GP): *English*

Laboratory used: *Observing with Nasa*

Type of Education (Primary or Secondary): *Primary, Secondary*

Users' access (free, guest, login needed): *There are two modes of access to the MicroObservatory telescopes:*

- *The **Guest Observer Portal** is freely available to anyone with a valid email address at this URL: <http://www.microobservatory.org/>*
- *The Full Access Telescope Control Center is available on a limited basis through classroom user accounts obtainable by application. To apply for a Full Access guest observer account, you must submit a proposal at the following URL: <http://mo-www.harvard.edu/MicroObservatory/Enroll>
(This mode of access to the MicroObservatory telescopes allows for more individual control of the telescope parameters, but also requires more time and effort for students and teachers to achieve successful observing results. Users whose proposals are approved will receive an access code with instructions by email.)*

In-depth description of the laboratory: *This laboratory is a network of automated telescopes that can be controlled over the Internet. The telescopes were developed at the Harvard-Smithsonian Center for Astrophysics and were designed to enable youth nationwide to investigate the wonders of the deep sky from their classrooms or after-school centers. They are located and maintained at observatories affiliated with the Center for Astrophysics, including locations in Cambridge, MA and Amado, AZ.*

The network is composed of several 3-foot-tall reflecting telescopes, each of which has a 6-inch mirror to capture the light from distant objects in space. Instead of an eyepiece, the MicroObservatory telescopes focus the collected light onto a CCD detector (an electronic chip like that in a digital camera) that records the image as a picture file with 650 x 500 pixels.

Students and teachers control the MicroObservatory telescopes and download their images themselves, with no human intervention in the loop. Students reserve telescope time, check weather, choose targets, select exposure times, color filters and other parameters. Normally, users access the telescope site anytime during the day and request that an image be taken that night. Students thus control the instrument as needed, without dependence on a telescope operator or other outside "experts."

Activities related to the laboratory (if any): *All related information can be found here: <http://mo-www.harvard.edu/OWN/projects.html>*

Learning materials needed in order to carry out the laboratory (remote or virtual): *Students need to have access to the Remote telescope.*

For most of the activities students will need to use image-processing software so they need to download the image-processing program, MOImage.

The MicroObservatory Image Processing Software (MOImage) can be downloaded directly from this web site: <http://mo-www.harvard.edu/MicroObservatoryImage>

Background knowledge needed: *Basic astronomy concepts and telescope terminology.*

Type of experiment (individual or cluster of many experiments): *Individual experiment composed by a network of automated telescopes that can be controlled over the Internet.*

Experiment plans available (if any): No available information

Feedback mechanisms in order to collect information from users: System collects the following information in order to understand who is using the laboratory:

- Email address
- Age
- Gender
- State (for US)
- How often have you used these telescopes?
- How would you rate your astronomy knowledge on a scale of 0 to 10 if 0 is "no knowledge at all" and 10 is "astronomy expert?"
- May we contact you in the future about your MicroObservatory use?

Validation experience (number/types of schools/students): No information available

4. Adaptations and extra information

4.1. Replacement of original GPs

As it was already mentioned in Section “4.4 Adaptation” of “D.2.1 Identification of Good Practices”, two (2) of the original selected GPs:

- The Planets & their Characteristics
- Observations of the Galaxy

Have been replaced by:

- Analysing Lunar Craters
- Saturn Seasons

4.2. New GPs in-depth analysis

4.2.1. Analysing Lunar Craters

General information

- a) Basic information on the GP with a general description: *Project to investigate crater impacts on different regions of the Moon*
- b) GP URL: <http://www.cosmosportal.eu/cosmos/en/node/3657>
- c) Subjects (Subjects covered by the GP): *Astronomy*
- d) Author (Creator of the GP): *Cosmos portal*
- e) Languages (Current language of the GP): *English*

Laboratory used: *DSpace*

Type of Education (Primary or Secondary): *Secondary*

Users' access (free, guest, login needed): *Login is needed but registration is free and simple.*

In-depth description of the laboratory: *The project gets students to look in detail at images of the Moon to determine whether the density, size and appearance of craters vary across the lunar surface.*

Activities related to the laboratory (if any): *A number of activities are suggested under: http://www.cosmosportal.eu/cosmos/files/uploads/objects/Lunar_Craters.zip*

Learning materials needed in order to carry out the laboratory (remote or virtual): *Images of the moon are needed but they are all provided in the file: http://www.cosmosportal.eu/cosmos/files/uploads/objects/Lunar_Craters.zip*

Background knowledge needed: *Provided under: http://www.cosmosportal.eu/cosmos/files/uploads/objects/Lunar_Craters.zip*

Type of experiment (individual or cluster of many experiments): *Individual*

Experiment plans available (if any): *n/a*

Feedback mechanisms in order to collect information from users: *None available*

Validation experience (number/types of schools/students): *Not available*

4.2.2. Saturn Seasons

General information

- a) Basic information on the GP with a general description: *Project helping students to understand what causes the change of seasons and how much time it takes for Cronus to perform a full rotation.*
- b) GP URL: <http://www.cosmosportal.eu/cosmos/en/node/56061>
- c) Subjects (Subjects covered by the GP): *Astronomy*
- d) Author (Creator of the GP): *Cosmos portal*
- e) Languages (Current language of the GP): *Greek*

Laboratory used: *DSpace*

Type of Education (Primary or Secondary): *Both*

Users' access (free, guest, login needed): *Login is needed but registration is free and simple.*

In-depth description of the laboratory: *Project helping students to understand what causes the change of seasons and how much time it takes for Cronus to perform a full rotation. Images taken from Hubble are used and students are taught how to use trigonometry in order to calculate angles and extract conclusions.*

Activities related to the laboratory (if any): *A number of activities are suggested under: http://www.cosmosportal.eu/cosmos/files/uploads/objects/Saturn_Seasons_GREEK.zip*

Learning materials needed in order to carry out the laboratory (remote or virtual): *Information provided: http://www.cosmosportal.eu/cosmos/files/uploads/objects/Saturn_Seasons_GREEK.zip*

Background knowledge needed: *Provided under:*
http://www.cosmosportal.eu/cosmos/files/uploads/objects/Saturn_Seasons_GREEK.zip

Type of experiment (individual or cluster of many experiments): *Individual*

Experiment plans available (if any): *n/a*

Feedback mechanisms in order to collect information from users: *None available*

Validation experience (number/types of schools/students): *Not available*

5. Conclusions

Carrying out the in-depth analysis for the selected GPs, provided all necessary information regarding their individual needs as long as their particularities related to their individual subjects, technical requirements and availability of resources. The analysis also revealed a number of inadequacies i.e access to labs issue, incomplete learning resources that the partnership will take on board and address before and during the development of the UniSchoolLabS Toolkit.

