

Kingdom of Saudi Arabia

**EXTENSIVE ASSESSMENT OF INDIVIDUAL EXPERIMENTS
IN A SYSTEMIC APPLICATION OF GREEN CHEMISTRY
VERSUS THEORETICAL SYSTEMS IN SAUDI ARABIA**

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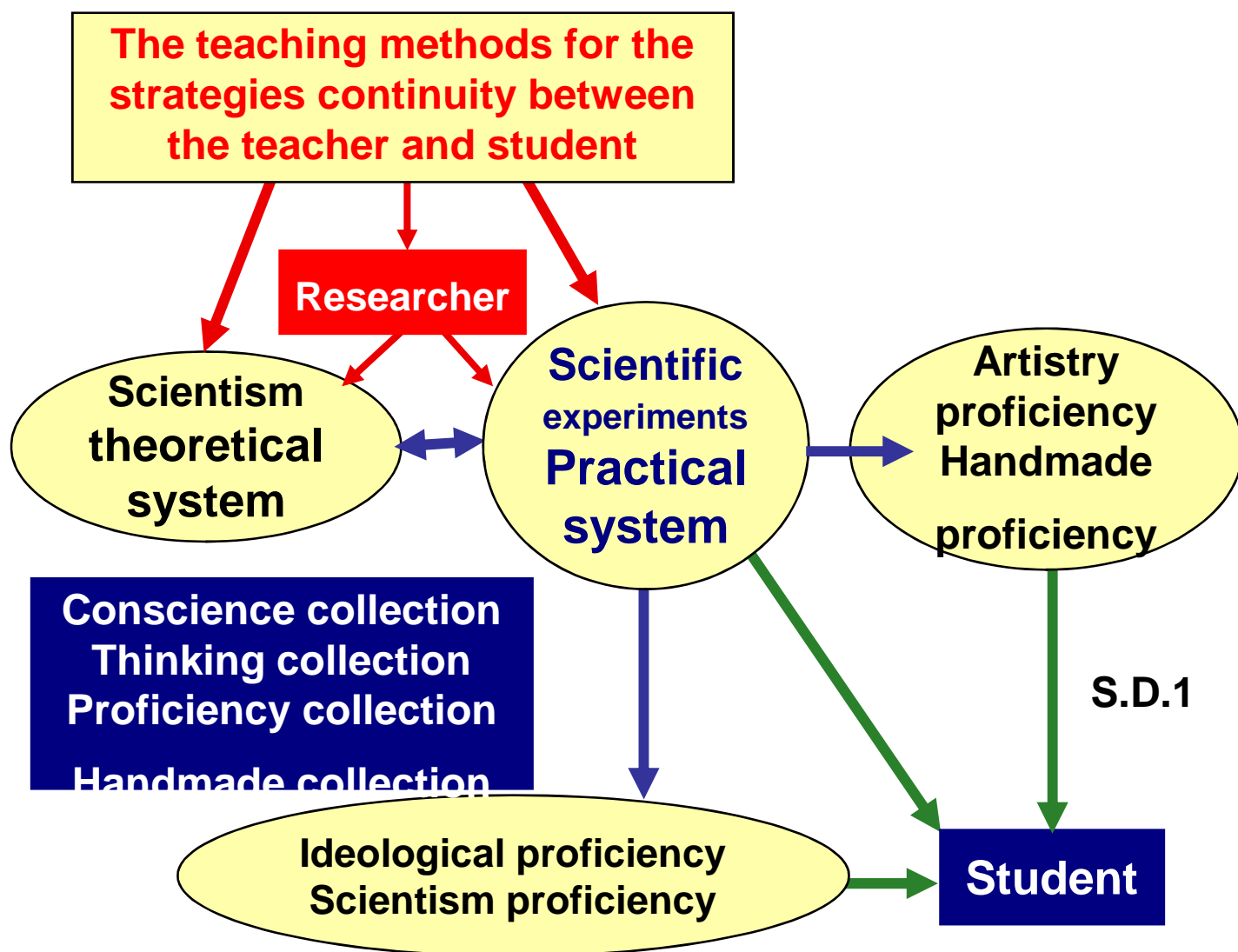
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Ali M. Hadi⁴

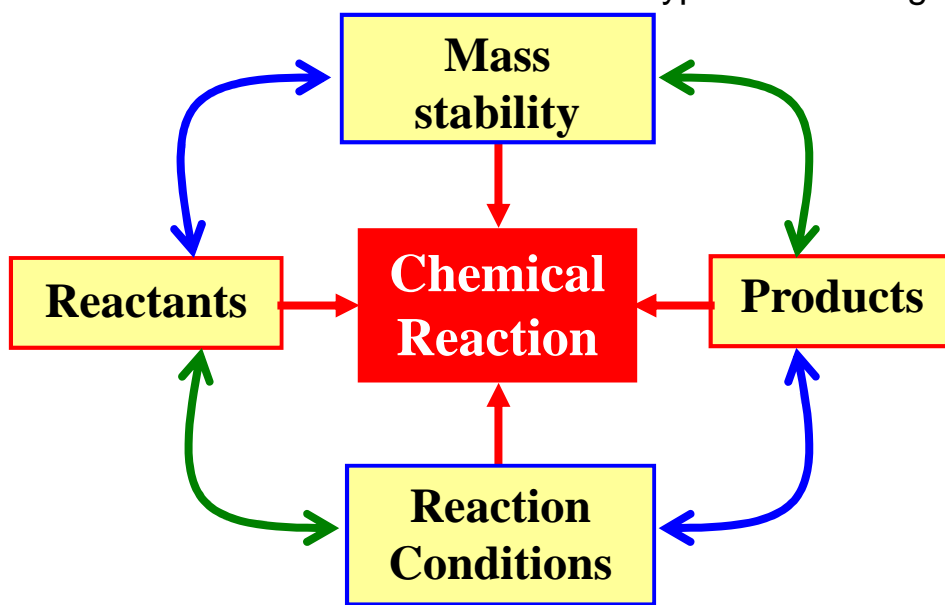
**Secondary School⁴
(Jeddah)**

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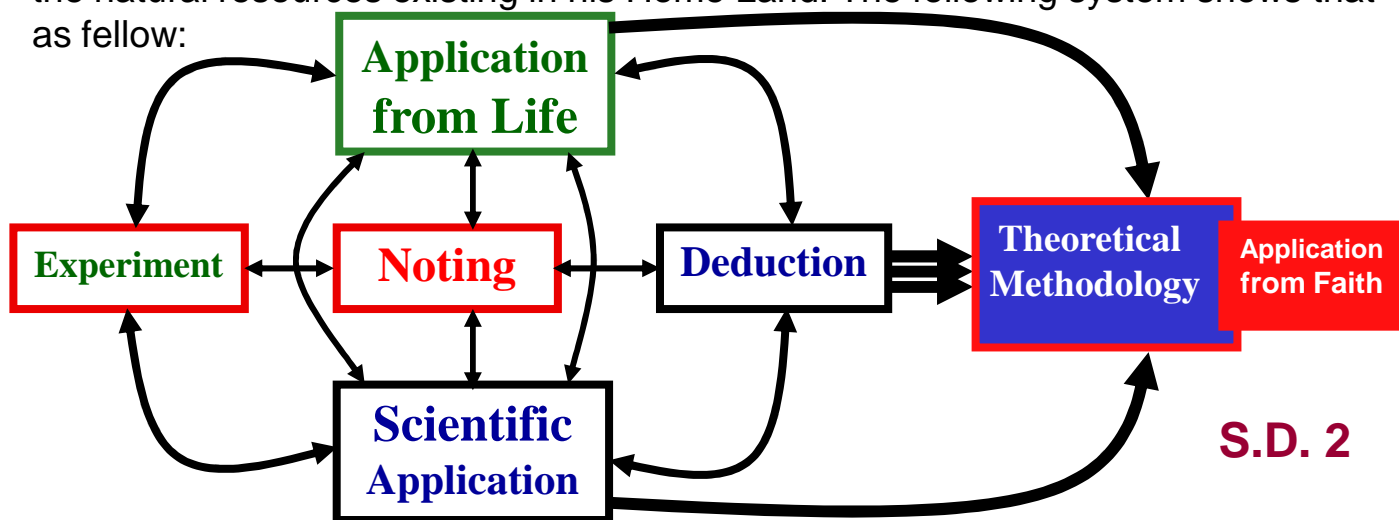
From our experience in the application of the green chemistry program on the experiment laboratories at secondary school stage in Kingdom of Saudi Arabia, since 2003. We find that the use of instrument plastics which supported by South Africa, has a good interest importance in the field of the theoretical system for chemistry, biology and physics topics. Now a days all of the students want to carry the most of investigation with the apply of the green chemistry on the topics of Faculty of Education, and on the foundation chemistry for first year at faculty of science at K.S.A. The following systemic approach (S.D. 1) its clear cut the relationship between theoretical and practical systems.



The following system shows the systemic relation between the types of reactants and products in chemical reaction that depends on mass stability and reaction conditions, as for example, the reaction between chlorine gas with toluene gives a benzyl Chloride under the light (by radical mechanism). But, if we add aluminum chloride to the reaction, we will find that the result is a mixture of o- and p-chlorotoluene. We observe that the relation conditions control the types of results and the difference of reactants mole affect on the type of some organic actions.



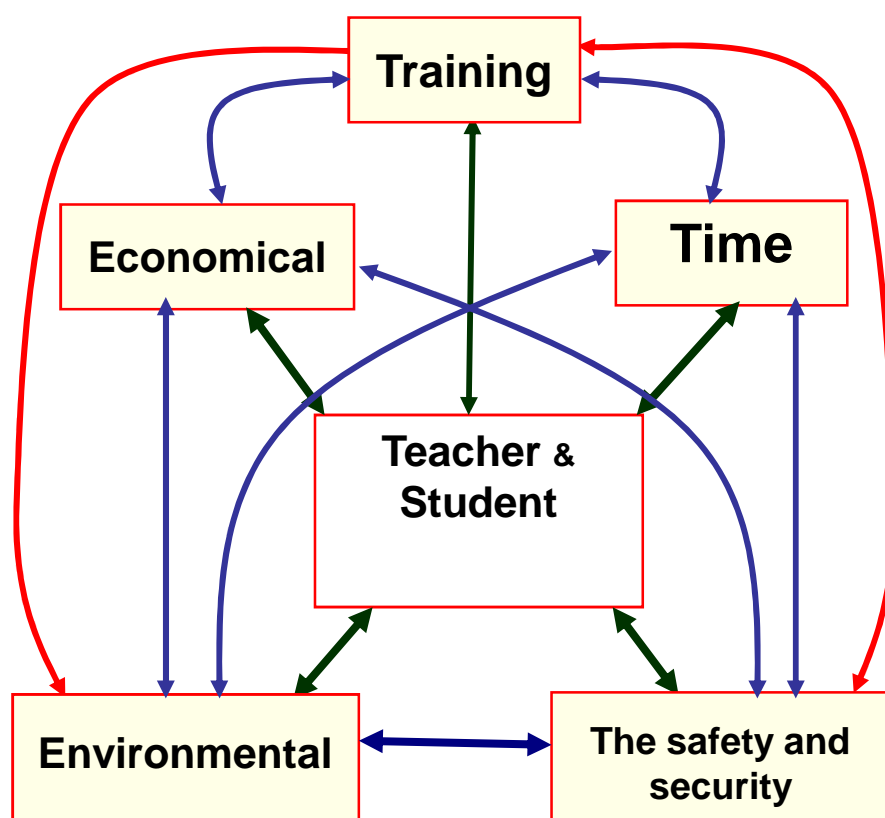
The systemic approach 2 shows the systemic relation between the lab. Experiments and theoretical and scientific methodology of any subject. Also, the application in life can't be perfect except the outputs of education on the level of scientific performance competence quality (that supports the cognitive structure of the student) is next to linking the theoretical and scientific methodology with faith and applied examples in the environment where the students live which depend on the natural resources existing in his Home Land. The following system shows that as follow:



S.D. 2

It is clear from the conceptions of science and the information to the students in the class with easy method, short time by using such the green experimental methods in front of the student. Moreover, with at less exhaustion, and well be considered as environmental friends (S.D. 2). Rally, the scientific application for green sciences is cheap comparing with the traditional laboratories and most of experiments (about 90%) concerning with Chemistry, Physics and Biology in the secondary stage don't have more than ten10 minutes except the scientific experiments concerning with Agriculture and Microbiology which need enough time that suites their experiments conditions. Most of experiments (about %95) are considered easy and safe comparing with performing these experiments by using the traditional requirements in laboratories.

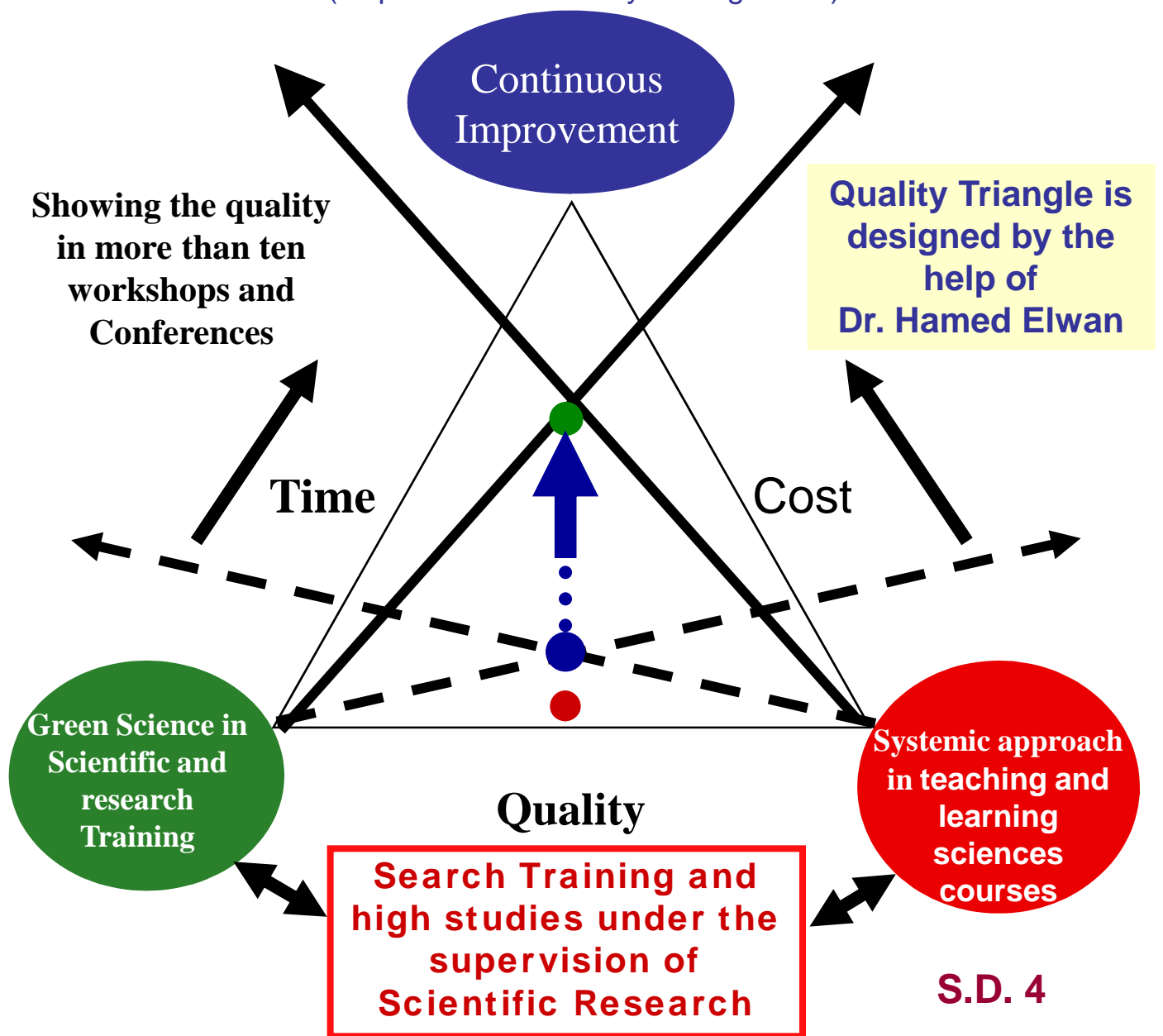
Mecroscale Green Sciences can be defined as: it is a modern scientific technology that is applied in all scientific experiments and is a friend of the environment in the term of the green plant chlorophyll doesn't make pollution because the garbage of chemical reactions are very little. Also, this technology has low cost, safe, needs short time and easy to be carried out comparing with performing these experiments in the traditional laboratories.



S.D.3

Quality triangle (S.D. 4) shows the ability of developing education structure and the quality of educational institutes outputs and defining a strategy of continuous improvement of educational process with low cost and short time as both cost and time are considered very important standards in measuring the rate of education quality in any country all over the world. So, we represent for the participants in the conference that applying the **systemic approach** (as a methodology in the educational institutes) and **green science** (to perform the scientific experiments) are **considered two perfect strategies for continuous development of the educational process with low cost and short time.**

The following system shows that the quality triangle was designed by the help of Dr. Hammed Elwan (expert in Total Quality management).

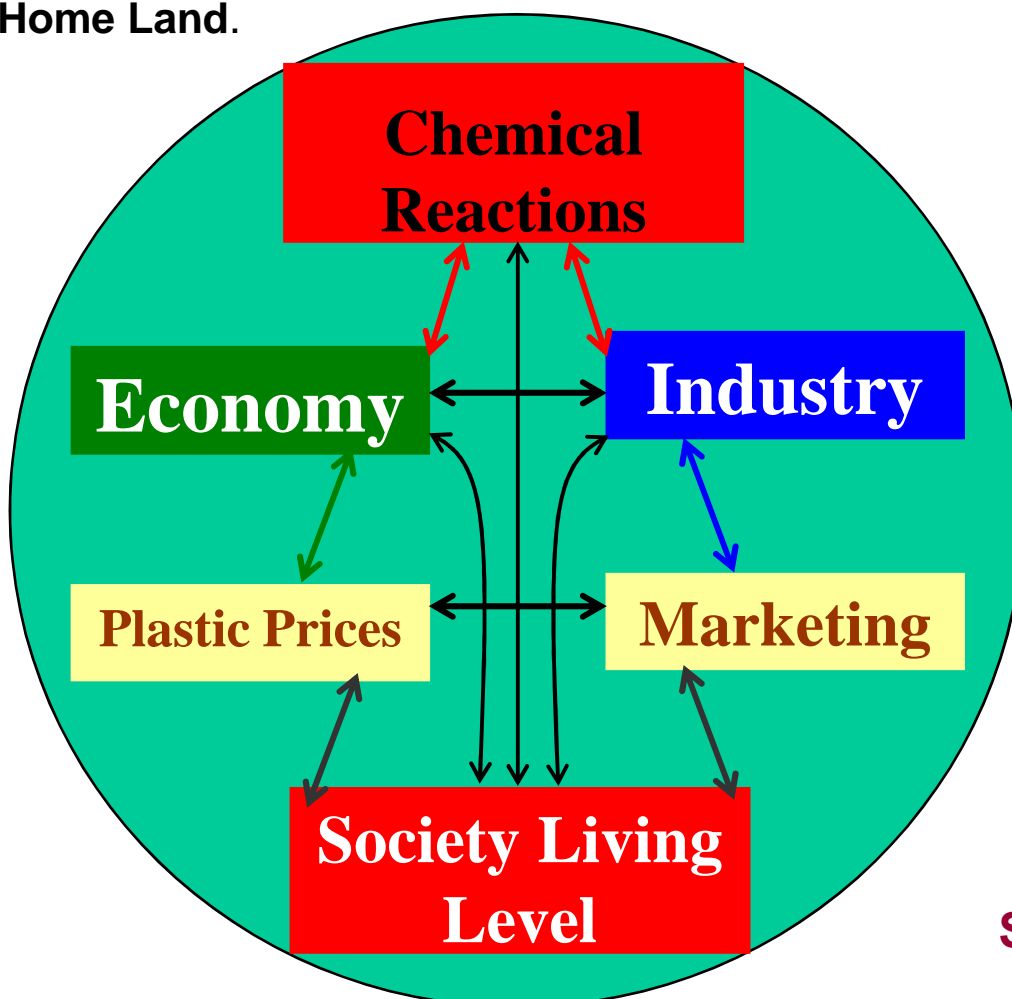


We can put a definition for the **systemic** approach as follow:

“A methodology that considers recognizing the universal phenomenon and linking the scientific concepts in the heart to think of it deeply to reach at marks that show the greatness of God”

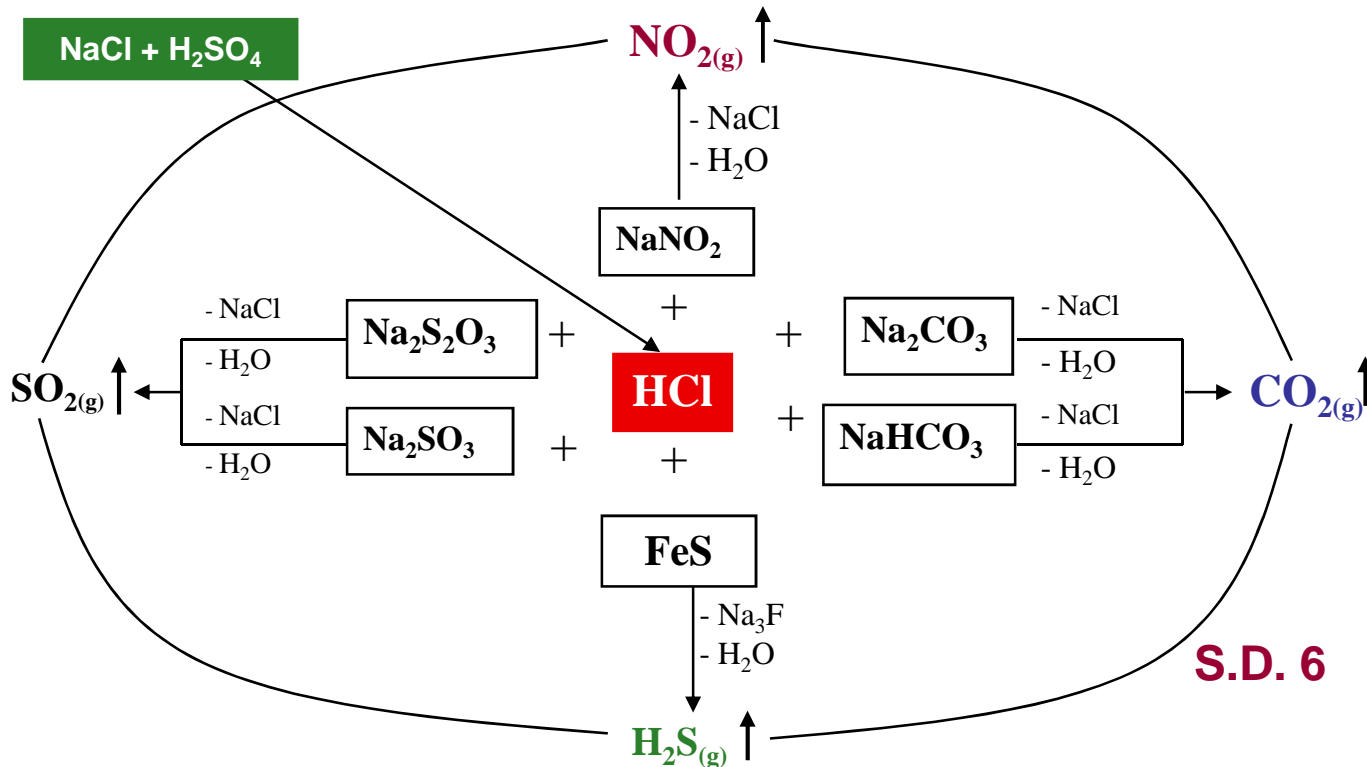
The following system is a good proof to enlarge the student’s perceptions and to train them on how to link the materials of Chemistry, Physics and Biology with: (1) Industry, Agriculture and their Relation, (2) Country Economy, (3) Marketing, (4) Natural Resources and their World Prices, (5) The relation of these concepts and its Usage Mechanisms to Achieve High Living Level among Developed Countries.

As a result, this achieves the creative growth for our sons and daughters to help them **to achieve the Sustainable Development in their Home Land.**



S.D. 5

The requirements of **Micro Scale Green Sciences** are used to perform all the experiments of the following system and succeeded in training the learner on how to discover these gases and write the equations of the experiment easily.



Reference: scientific book covers the course of general basis of chemistry:
System of Green Chemistry Experiments in General Chemistry Basis

Finding the size of one mole of any gas is one of the experiments that is performed by using Microscale requirements.

Finding mole size from a gas under the standard conditions

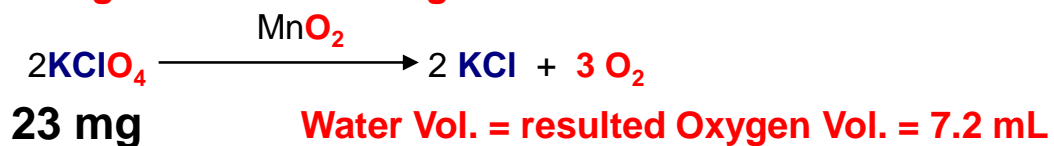
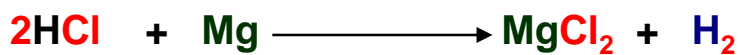


Fig. 1

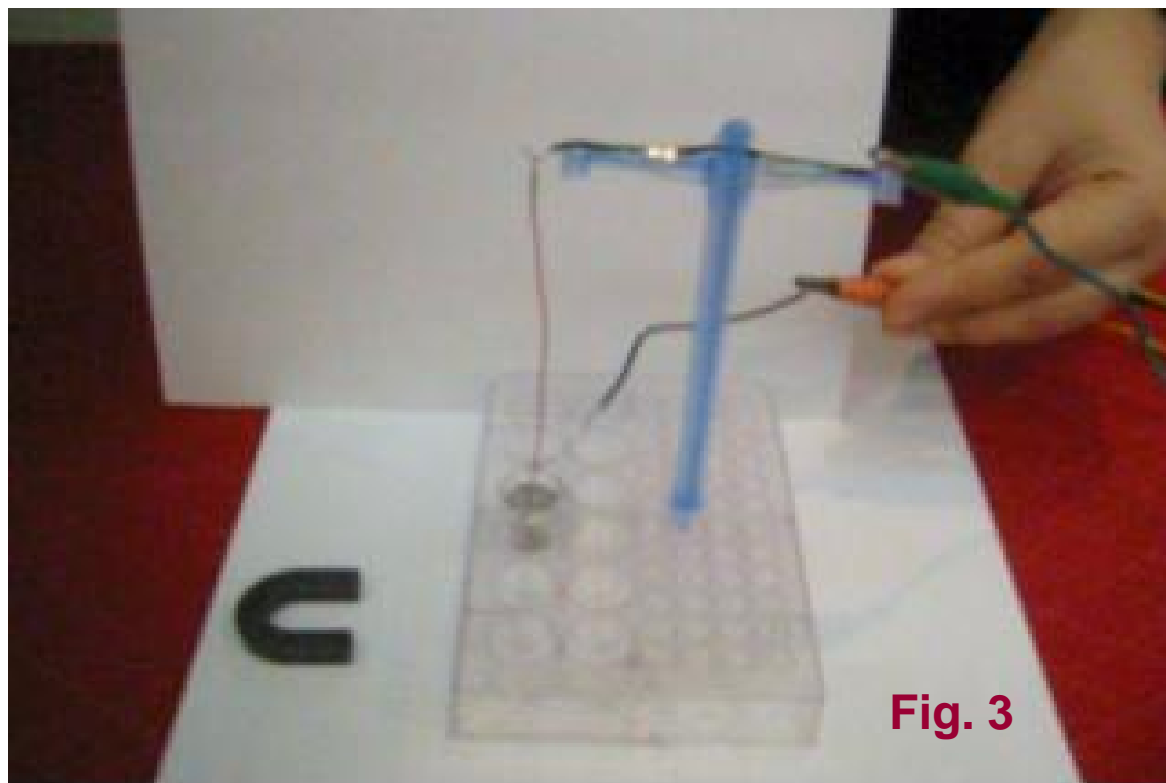
The following appliance is designed (by using the requirements of green sciences) to find gas constant by recognizing the size of resulted Hydrogen.



0.5 ml 1.13 mg 12 ml



The teacher of physics Sameerah Al Gefry designed this appliance of physic bottle requirements using the main and side stand of chemistry bottle to perform the experiment



Names of the Requirements Bottles that bought from South of Africa and are used in the most of Science Experiments for the Secondary School and the first year of Sciences College

No	Items
1	MicroChem Advanced Kit Special
2	MicroChem Basic Kit
3	MicroChem Tit ration Kit
4	MicroChem Micro burette Kit
5	MicroChem Combo-Still RSA Steel Materials Bottle for Chemical Experiments
6	Micro- Organic Kit

Most of the requirements of Physics, Biology and Water Sciences experiments are Provided

Microphysics Basic Electricity Kit;	Microchem Chemicals Grade 8&9
Physics Forces Dynamics Motion Kit	Microchem Chemicals Grade 10
Physics Waves Light Sound & Optics Kit	Microchem Chemicals Grade 11
Microphysics Electricity Resource Kit	Microchem Chemicals Grade 12
Microbio Simulated Blood Typing- ABO/Rh	Microchem Chemicals Organic
Microbio Radmaste Grade 12 Resource Kit	Microbio Radmaste Grade 12 Chemical Kit
Biology Student Kit Grade 12	Multimeter (Digital) DCA 200 μ A-10A
MicroLife Water Field Kit	Galvanometer Sensitive -300 μ A ~0~300 μ A
MicroLife Water Quality Testing Kit (RSA)	

The physic teachers Buthainah Bokhary and Abeer Kashkary designed a worksheet to perform the experiments of magnetic electricity as follow

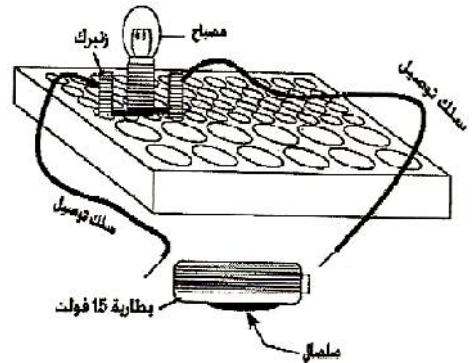
Worksheet (connecting the Electrical Cells)

Group ()

First: contact the circle consequently

(A) contact the circle as in the figure (B) Note the results in the table

Number of Batteries	Light Intensity	Current Intensity	Effort Difference between the two sides of lamb
1			
2			
3			



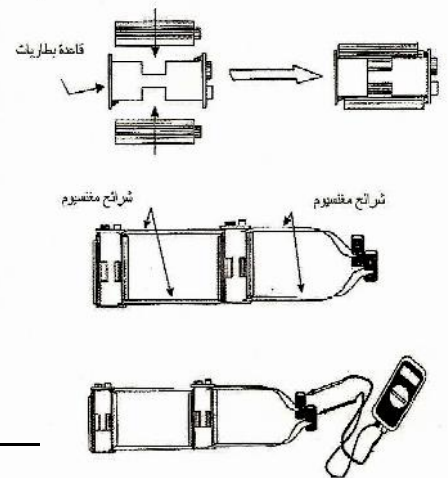
Result

.....

Second : contact the circle by parallel connection

(A) contact the circle as in the figure (B) Note the results in the table

Number of Batteries	Light Intensity	Current Intensity	Effort Difference between the two sides of lamb
1			
2			
3			



Result

.....

Third : mixed connection of the generators

(C) contact the circle as in the figure (D) Note the results in the table

Number of Batteries	Light Intensity	Current Intensity	Effort Difference between the two sides of lamb
1			
2			
3			

Result

.....

We want to show the uses of **Micro Scale Green Science program** as follow:

- 1) Training the teachers to perceive modern technical technology and to help the students for self education.
- 2) Creating interest and excitement during performing the experiments by using the bag in the which help the students to analyze and understand in order to achieve the creative and skillful gaining of talents.
- 3) Helping the teachers to recognize that gaining the science is easy and suites small and rented schools in addition to education in groups in both private and public schools.
- 4) Suites all education stages and different ages.
- 5) Made from a substance that doesn't fragile and has high level of safety and security.
- 6) Easy to be carried or transferred.
- 7) Developing the skillful side and the technical sense of the students as one of sustainable development supports.
- 8) Solving all the problems that the teachers face during performing the experiments by the traditional ways.
- 9) Decreasing the pressure on school laboratories.
- 10) Economical and safer on health and establishments.
- 11) Both teachers and students can perform the experiments at home.
- 12) Providing the students with atmosphere of observing and watching the experiment and think to reach at applied results in life that suite the content of theoretical courses.
- 13) Helping to assure that examiners of the scientific experiments in the secondary stage is safe by the laboratory technician.
- 14) The teachers can perform the scientific experiments inside the classroom at the beginning of the lesson during illustrating the lesson that concerns with the experiment as it has ten minutes to be performed and the student can watch how to do it and note its results. Rally, this is reflected on raising the student's level of understanding.
- 15) Training the students in the laboratory to use an advanced bag of chemistry to raise their technical practical level and this is rally reflected on raising their level in the practical sessions in any specialization at the university where the students are admitted.
- 16) All the experiments(that the teacher cant perform in the school laboratory) can be performed.
- 17) Using the experiments bag to perform the secondary stage experiments utilizes very low amount of chemical substances which decreases the economical cost and its dangers during performing the experiments on Microscale.

Workshops that performed to define the program of Micro Scale Green Sciences:

- (1) Forum about the dangers of chemicals and how to treat it in 1994.
- (2) Several workshops about the systemic teaching in UNIVERSITY DEVELOPMENT CENTER at King Abdulaziz University from 1990 to 1995.
- (3) Making a workshop for two days (daily two hours) for the secondary stage teachers and supervisors in the Ministry of Education in King Saud University. The organizer side was under the presidency of Dr Al Farhan and Saudi chemical Institute in 2003, (the workshop was evaluated – 30 participants) and the lecture was about a strategy of Developing the Chemistry Course of the first year of the secondary stage and It was introduced in Eighteenth World International Conference in Istanbul (Turkey) in August 2004.
- (4) Making the applied session (An Introduction to Comprehensive Quality and Systemic Entrance), Organizer side was Drs/ Gawaher El Mahdi and Sameerah El Gefery in the Administration of Development in Jeddah Department in 2004.
- (5) Making a workshop for the kingdom region's supervisors - Organizer side was Drs/ Gawaher El Mahdi and Sameerah El Gefery in the Administration of Development in Jeddah Department in 2004 (the workshop was evaluated – 15 participants).
- (6) Third Annual Meeting in Jeddah Educational Department in 2005 (Experiment Performance was evaluated by Micro Scale).
- (7) Workshop in Teachers College in Jeddah under the care of College Dean in 2005 (Experiment Performance was evaluated by Micro Scale).
- (8) Workshop in the schools of the kingdom in Riyadh in 2005 (the workshop was evaluated- 20 teachers).
- (9) Workshop for the supervisors in 2005 and the organizer side was Development Administration in the Ministry of Education in Kuwait (the workshop was evaluated- 50 teachers).
- (10) Workshop for the Doctors in 2005 and the organizer side was Development Of Applied Medicines in Kuwait (the workshop was evaluated).
- (11) Making workshop for Physics teachers in Development Administration during the last 6 months, 2006.
- (12) Making workshop in Chemistry Department in King Abdulaziz University in 2006 (the workshop was evaluated- 50teachers).
- (13) The first meeting "Woman Role in Serving the Society" – the organizer side was the College of Education for Scientific Departments in Jeddah in 2006 (Lecture of Green Micro Scale Sciences was Evaluated – 40 Participants).
- (14) Workshop in the Ministry of Education in K.S.A (Riyadh) in 2006.

The Following Questionnaire was introduced in Workshop and General Lectures to Obtain the Participants Point of Views and It was as the follow:

Questionnaire of Workshop Evaluation(example: Ministry of Education in Riyadh).

Title: Green Sciences and Sciences experiments for technologies and courses supervisors, teachers and educational supervision.

Dear Participant: this questionnaire helps you to express your point of view freely about green sciences program to develop the educational process with our interest with our interest in any opinion that lead to perfect educational future.

Sex: **Male** **Female**

Methodology Supervisor **Technical Supervisor** **Educational Supervisor** **Teacher**

Specialization..... Years of Experience..... Scientific Certification.....

First: Green Sciences Lecture

No	Statement	Excellent	Good	Acceptable	Weak	No
1	Your information about green sciences before lecture	0	2	4	30	36
2	Your information about green sciences after lecture	30	4	2	0	36
3	Importance of green sciences in performing the scientific experiments	34	2	0	0	36

Second : showing chosen experiments by using computer

No	Statement	Excellent	Good	Acceptable	Weak	No
1	Your estimation for showing the experiments by computer	24	9	3	0	36
2	Your profit from this show	27	6	2	0	36

Third : Requirements of scientific experiments in Chemistry, Physics and Biology

No	Statement	Excellent	Good	Acceptable	Weak	No
1	The rate of attracting the attention and interest	20	14	2	0	36
2	The rate of the suiting the new in laboratory technology	20	13	2	1	36
3	The rate of experiment achievement for aims of sciences courses	20	12	3	1	36
4	The rate of participation in saluting the problems of the laboratories of rented and night schools	26	6	2	2	36
5	The rate of helping the development teacher's practical skills	22	9	5	0	36
6	The rate of concentration on teacher during practice and work	21	11	4	0	36
7	The rate of easiness of its usage	21	15	0	0	36
8	The rate of summarizing the steps of laboratory experiments	27	8	1	0	36
9	The rate of possibility to perform the scientific experiments concerning with the subjects inside the classroom	29	5	2	0	36
10	The rate of providing positive reaction with the students	26	8	1	1	36
11	The rate of providing the chances of creative thinking	18	16	1	1	36
12	The rate of suitability with the student mental abilities	17	15	4	0	36
13	The rate of caring with the technical sides	21	13	1	1	36
14	The rate of providing time	32	2	2	0	36
15	The rate of providing safety and security	26	5	5	0	36
16	The rate of providing chemicals with low cost	30	4	1	1	36
17	The rate of influencing on the environment	24	4	2	6	36

Do you like to have the laboratory bag in your laboratory
Do you want to train on using the laboratory bag
Recommendation:.....

Yes **No**
Yes **No**

From 17 standards (that mentioned in the above questionnaire's result), it shows that the participants' opinions were more than %90 and Micro Scale science experiments in Chemistry, Physics and Biology (15 participants) were excellent.

The result of showing 13 chemical participants (8 supervisors and 5 teachers) from: Questionnaire of evaluating the technology of Green Micro Scale Chemistry Laboratory on Tuesday 2006.

The results of their point of views was as follow:

First: Showing Green Sciences Laboratory

No	Statement	Excellent	Good	Acceptable	Weak	No
1	Laboratories level concerning with preparations	9	4	0	0	13
2	Level of books that shows the ways of performing the experiments	4	5	3	1	13
3	Importance of green sciences in performing the scientific experiments	9	4	0	0	13

Second: : showing chosen experiments by using computer

No	Statement	Excellent	Good	Acceptable	Weak	No
1	Your estimation about showing the experiments by computer by using green sciences technology	7	3	2	1	13
2	Your profit from this show scientifically	4	8	1	0	13

Third : Requirements of scientific experiments in Chemistry, Physics and Biology

No	Statement	Excellent	Good	Acceptable	Weak	No
1	The rate of providing all requirements of transitive laboratory	7	6	0	0	13
2	The rate of providing all chemicals in chemical laboratory	8	5	0	0	13
3	The rate of achieving the experiments requirements for science course aims	7	4	2	0	13
4	The rate of technology application possibility on some chosen schools in many regions in the kingdom	10	3	0	0	13
5	The rate of your agreement to train the teacher on chemistry technology in the secondary stage	12	1	0	0	13
6	The rate of your prediction through your participation for the success of applying the technology in the schools	8	5	0	0	13
7	The rate of the appearance of transitive chemical laboratory.	8	4	1	0	13
8	The rate of possibility to organize the requirements of the chemical laboratory on the table that shown in the workshop	8	4	1	0	13

By looking at the chemistry teachers and supervisors' point of views , they agree greatly with training and providing the requirements in some schools in the kingdom. Also, they saw that the program will success (%90) when the schools apply it.

**The result of looking at four physical participants (teachers and supervisors) from
Questionnaire of evaluating the technology of Green Micro Scale Physics
Laboratory on 2006**

The results of their point of views was as follow:

First: Showing Green Sciences Laboratory

No	Statement	Excellent	Good	Acceptable	Weak	No
1	Laboratories level concerning with preparations	2	2	0	0	4
2	Level of books that shows the ways of performing the experiments	1	2	1	0	4
3	Importance of green sciences in performing the scientific experiments	3	1	0	0	4

Second: : showing chosen experiments by using computer

No	Statement	Excellent	Good	Acceptable	Weak	No
1	Your estimation about showing the experiments by computer by using green sciences technology	3	1	0	0	4
2	Your profit from this show scientifically	2	1	1	0	4

Third : Requirements of scientific experiments in Chemistry, Physics and Biology

No	Statement	Excellent	Good	Acceptable	Weak	No
1	The rate of providing all requirements to perform the physical experiments	2	2	0	0	4
2	The rate of achieving the experiments requirements for science course aims	2	2	0	0	4
3	The rate of technology application possibility on some chosen schools in many regions in the kingdom	2	1	1	0	4
4	The rate of your agreement to train the teacher on physics technology in the secondary stage	4	0	0	0	4
5	The rate of your prediction through your participation for the success of applying the technology in the schools	1	3	0	0	4
6	The rate of the appearance of physical requirements that shown on the table	2	2	0	0	4
7	The rate of possibility to organize the requirements of the physical laboratory on table that shown in the workshop	1	3	0	0	4

In the same way we are taking with many teachers in such field and with the students about this ideas, and we used our questionnaire with a team workers from King Abdulaziz University together with Faculty of Education (Girls) and some secondary schools at Jeddah (K.S.A), concerning that, the experiments could be carrying before each quotient and before illustration of emplaced to realize success resting an the net of questionnaire. Therefore we wish to distribute to help each teacher per each state for use its as a reference to elevate the level of teaching in Saudi Arabia.

Appraisal questionnaire of each experiment in the green scientific program

The scientism: course: The name of exp.:
 Teacher name: The purpose from exp.:
 Observation: Results: Comments:

Put yes or no and/or other suitable symbol on the ration of percentage in the using of the green scientific technique:

No.	Statement	--	--	--	--	--
1	The rate of suitability exp. at your system order school	1	2	3	4	5
2	The easy in the run of exp.	easy	-	medium	-	Difficult
3	The time of demonstrated exp. With comparable traditional method	less in time		equal		Long than
4	The rate of safety and security through the exp. Running	1	2	3	4	5
5	The rate of pollution obtained from exp.	1	2	3	4	5
6	The rate of approach realization from the exp.	1	2	3	4	5
7	The rate of the significance technique for pupil student	1	2	3	4	5
8	The chemical quantity used in the exp. With other method techniques	Very little		Little		Medium equivalent
9	The ability of the student to accept that exp.	1	2	3	4	5
10	The rate of newness their technique	1	2	3	4	5
11	The rate of positive action at the time of running with your student civilized action , with insert.	1	2	3	4	5
12	Your insert. of laying lay this technique at your school	Stron gly		Normal		Refused
13	The rate in the use of systematic technique for the binding between the net results of exp . and the theoretical system	1	2	3	4	5
14	The extent of your opinion for lute of exp. Result with conclusion study system	1	2	3	4	5
15	The rate of the student assimilation for the theoretical part in which its supported the experiment	1	2	3	4	5

Results of questionnaire

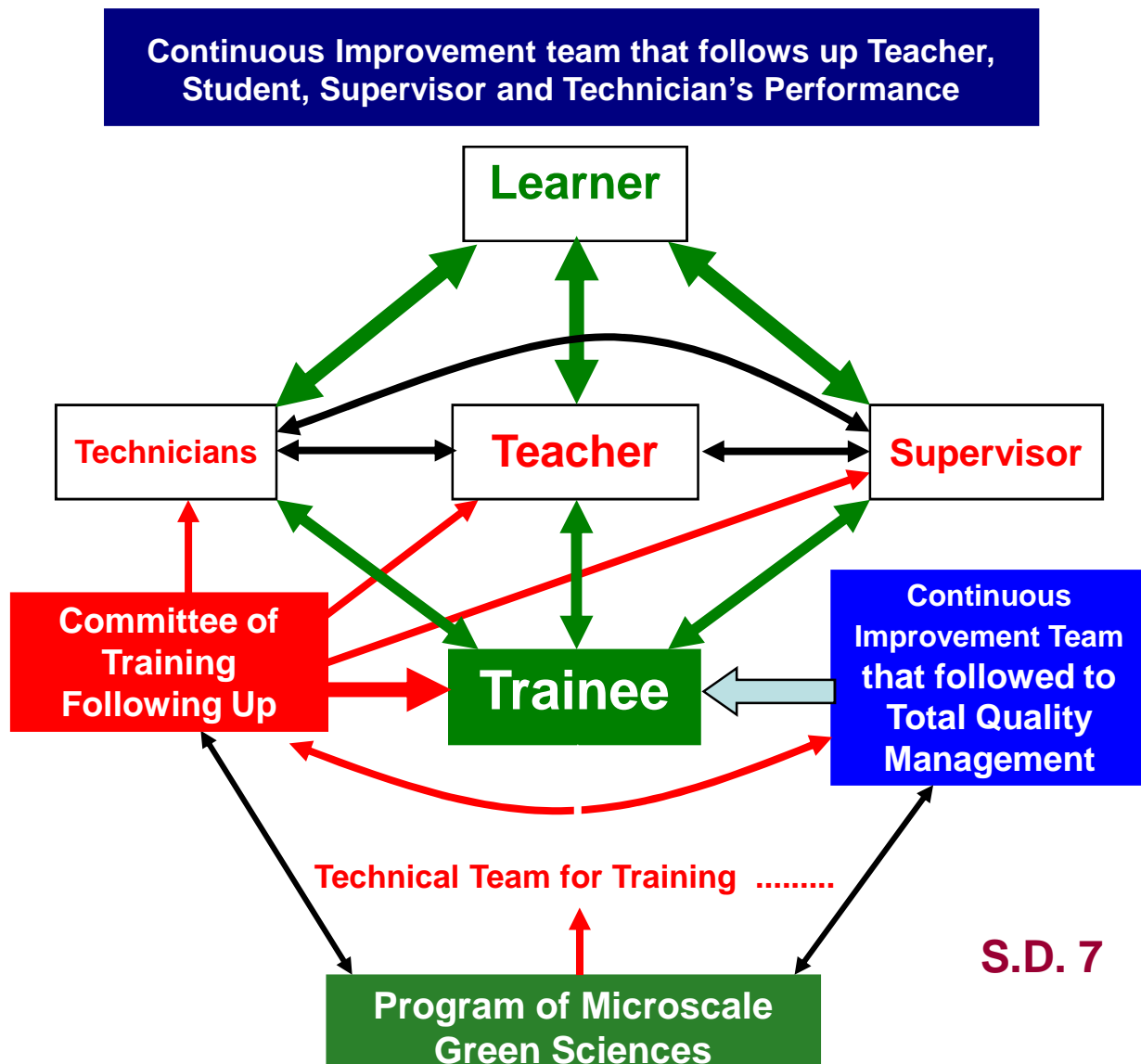
From the observations that made by Dr/ Hassan Al Bar, five chemistry teachers, eight physics teachers, teacher of biology and a great number of students and Master Degree students in Girls College (scientific departments) in Makkah in addition to Doctrine student in Girls College (scientific departments) in Jeddah, it was found that:

- (1) More than %90 of chemistry experiments that mentioned in chemistry courses (authenticated by the Ministry of Education) in all education stages can be performed practically by using the technology of Micro Scale Green Sciences without any problems may the teachers and the students face during performing these experiments when all the chemical and plastic substances are provided.
- (2) More than %90 of physics experiments (concerning with Electrical Magnetism) that mentioned in physics courses (authenticated by the Ministry of Education) in all education stages can be performed practically by using the technology of Micro Scale Green Sciences without any problems may the teachers and the students face during performing these experiments when all the chemical and plastic substances are provided. But %85 of light, sound and visuals experiments can be performed in the Saudi courses.
- (3) More than %90 of biology experiments that mentioned in biology courses (authenticated by the Ministry of Education) in all education stages can be performed practically by using the technology of Micro Scale Green Sciences without any problems may the teachers and the students face during performing these experiments when all the chemical and plastic substances are provided.
- (4) Most of experiments that are concern with courses of chemistry, physics and biology of first science year can be performed using the technology of Micro Scale Green Sciences without any difficulties may the students face during performing these experiments.

We want to represent the result of participants' point of views in the workshops that was performed in the Ministry Of Education in Riyadh and Kuwait

- (1) 36 questionnaires are collected from 41 questionnaires that concentrated on the following(five participants didn't give their point of views)**
- (2) Their desires to obtain the requirements of experiments and to train on it.**
- (3) %90 of the participants didn't have information about the program.**
- (4) More than %90 of the participants had information about the program after the workshop.**
- (5) The percentage of participants' opinions concerning with the importance of green sciences in performing the scientific experiments was more than %90.**
- (6) Their estimation for the level of showing the experiments by computer was more than %80 concerning with local shows that is performed by the institutes' trainees.**
- (7) The participants'(36) point of views about the effect of scientific experiments requirements in Chemistry.**

The following system shows the strategy of the practical training program of performing the experiments of Micro Scale Green Sciences as follow



Most of scientific experiments translation that is written by professor John Bradley, his team work and IUPAC Organization that supported by UNESCO are translated from English to Arabic to help every students in our Kingdom to perform the experiments of “**Microscale green sciences**” easily.

Team work that supervised or performed Micro Scale Green Sciences in Jeddah and Makkah

se re	Name	specialization		Years of experience	Biking Free yes	Biking Free No	Nationality	experien ce
1	Dr/Hassan Al-Bar	Professor of Organic Chemistry	Organic Chemistry	27	-	X	Saudi	Consultan t
2	Dr/Maisaa Al-Rawi	Associated proof in Cytology &Histology	Biology Science	25	-	X	Saudi	Trainer
3	Dr/Amerah Al-Attas	Associated proof in Analytical Chemistry	Analytical Chemistry	22	-	X	Saudi	Trainer
4	Ali Masoud	Master Degree	Vital Chemistry	15	-	X	Saudi	Trainer
5	Hanadi Mohammed	Master Degree	Organic Chemistry	27	-	X	Saudi	Trainer
6	Ola Abu Al- Hassan	Bachelor of chemistry and Master Degree student unde supervision of Dr/Hassan Abdul Kader	Organic Chemistry	4	-	X	Saudi	Trainer
7	Abeer Kashkary	Bachelor	Physics	10	-	X	Saudi	Trainer
8	Bothainah Bokhary	Bachelor	Physics	10	-	X	Saudi	Trainer
9	Zahrah Al Ghamdy	Bachelor	Physics	10	-	X	Saudi	Trainer
10	Nahed Fadel	Bachelor	Biology	10	-	X	Saudi	Trainer