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The Effect of Flipped learning on the achievement of grade 11 students in Biology through enhancing specific skills (Formulating a hypothesis and schematizing a textual document)

Professional Master

in Teaching Biology

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Heba Salam
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ABSTRACT

Teaching students critical thinking skills is much more difficult than teaching them knowledge, since according to students, memorizing information is much easier of acquiring higher ordered skills. Besides, the class we teach is usually heterogeneous, not all students are able to learn within the same time the same concepts. In addition, the restricted number of assigned teaching hours and the race to finish the curriculum on time, don't always give the teacher enough time to balance between explaining the needed content and training students sufficiently on critical thinking skills especially in Biology at the secondary level. This caused, in my opinion, students to be low achiever in Biology. In this action research, we will try to solve the problem of low achievement of students in Biology through flipped learning.

Accordingly, this research aims to enhance the achievement of grade 11 /scientific students in Biology through enhancing specific skills which are formulating a hypothesis and schematizing a textual document by flipping the classroom.

A Flipped classroom is a form of blended learning where learners are asked to view short e-learning modules at home or on their own time, to prepare them for their in-person classroom training; so students are able to attend in-person sessions with specific, informed questions. Such e-lessons can be collected by the teacher from different resources or prepared by the teacher itself.

The study includes explaining, through flipped learning, an abstract theme in grade 11 which is gene expression, thus less time is needed for explaining such theme in class, which made me invest class time for training students on the mentioned skills. The content of flipped learning was prepared by the teacher using office mix, a Microsoft office tool.

The sample consists of twenty seven students from grade 11 scientific at a private school. Before the intervention students did a pretest for examining their knowledge in such skills and after the intervention a post test was conducted. The results were compared between pretest and posttest versions. In addition a questionnaire was performed to examine students' reflection toward flipped learning.

The findings suggest that flipped learning was an effective time management tool to train sufficiently students on critical thinking skills. The two research questions were validated.

Accordingly, through quantitative and qualitative analysis of such research it was clear that flipped learning was able to enhance students' skills thereby enhancing their achievement in Biology. Moreover, after analyzing students' responses in the questionnaire, students preferred to learn from time to time through flipped classroom, because they enjoyed learning on their pace!

Thus through flipped learning, I am able now to save class time for more practice instead the "chalk and talk" teaching style!

Key words: flipped learning, blended learning

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Chapter 1
Introduction

1.1 Purpose of the study

In such heterogeneous classes where students are of different levels and different learning styles it becomes harder for the teacher to fulfill all his students' academic needs within a restricted time given for the curriculum to be ended up. In addition teachers become more stressed when they teach grade twelve classes where such time will be much more limited. Concerning Biology it is among the scientific subject that does not only rely on skills but also on scientific language. And here comes the difficulty of teaching the requirements of such subject with such race of time with the curriculum. Thus one of the factors that makes students high achievers in Biology is to think critically so as to make their answers consistent with the assigned bareme. Accordingly class time is not enough for teaching students the whole content, within a limited time, and to make them practice sufficiently on solving requirements of each skill, consequently saving more class time to build students' skills without affecting time need to build their knowledge would be so helpful for making students high achievers in Biology .Through flipped learning I wanted to know whether I will be able to overcome such obstacles and save class time for making students practice more to acquire the needed skills accompanied with applying their knowledge in class to promote their achievement. So the purpose of the study is to investigate the effect of flipped learning on students' achievement in Biology for grade 11 students (scientific section) by enhancing specific skills which are formulating a hypothesis and schematizing a textual document.

1.2 Research problem

Teaching scientific reasoning skills usually starts from elementary classes. Passing to intermediate level almost all Biology teacher starts on orienting students' answers to match the requirements of official exams bareme. Same thing is happening with secondary level teachers. But here comes the gap!

In my school, which I have been teaching since 2010, I didn't touch a vertical coordination from one level to another especially between intermediate and secondary level. Where usually intermediate level teachers are not the same teachers that teach secondary level, and most of grade twelve teachers don't teach other lower secondary classes. Such misalignment made things harder with respect to me, as a grade twelve teacher, when I wanted to evaluate students' answers with accuracy. Actually I don't only teach my students to make them gain high grades in the official exams but I also tend to teach my students critical thinking skills which are needed later to succeed in career and life.

I used to review equally, at the beginning of each year, all of the needed skills in Biology according the evaluation system that matches the Lebanese curriculum, but honestly this method wasn't enough to make all of my students grasp sufficiently all the requirements for each skill. Especially that some skills to be taught sufficiently need more practice than other skill. For example it is easier to teach students how to pick out from a text the needed information than to teach them how to analyze a document.

Accordingly I have been suffering for many years from my students' negative attitude toward Biology since they study a lot but their grades are always beyond their expectation. It is not because they don't memorize well or they don't understand well, but actually what controls their achievement is the accurate bareme that relies on measuring competencies in Biology through specific skills. And unfortunately, there is limited time to finish the

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curriculum (especially for grades 9 & 12), thus there is no enough time for students to acquire equally all of the needed skills; Especially that I wait only for book exercises and sometimes exams correction to clarify such requirements. But that's not enough especially that the class is always a heterogeneous class between low achievers, high achievers & average student.

And since we can't change the number of teacher hours assigned I decided to manage my class time in an innovative way that matches such digital age.

Based on my experience, I realized that my students don't either try to formulate a hypothesis, they used to tell me," we don't think about it because we are sure it will be wrong"; especially when they are asked to formulate two hypothesis. In addition I have realized that students don't practice on schematizing a textual document. When I first asked grade 11 students to schematize a document, none of them answered it and they justified that they didn't learn it before although it is included in the evaluation system (see chapter 2, 2.1) since it is not being asked frequently in the official exams (Appendix D) however I see such skill is very important since it requires more than level of Blooms taxonomy.

Thus I decided to make my students knowledgeable in these two skills, which are formulating a hypothesis and schematizing a textual document.

In this action research, we will try to solve the problem of low achievement in Biology by enhancing the mentioned skills through flipped learning.

1.3 Research questions

1. Does being a high achiever in Biology rely mainly on understanding the requirements of specific higher ordered scale?

2. Can flipped learning be an effective tool to enhance students' achievement in Biology?

1.4   Significance of the study

Students are not used to be for a certain extinct self-learners; they got used that the only source of information is their teacher. In addition flipped learning is not restricted to any subject which makes it easily be integrated as an effective strategy in our curriculum. Such study will offer an alternative way for teachers in order to save more class time to train their students on action verbs so as they become prepared well for the official exams, not only academic wise, but also skill wise. Finally it will encourage teachers to update their course they used to teach to make it easier for self-learning which will thus promote their professional development.

Chapter 2
Theoretical background

2.1 Evaluation system of Biology according to the Lebanese curriculum

Based on the Ministry of Education [MOE], 2001, the Lebanese curriculum focuses on competences which include both content and skills.

Competency is the capability to apply or uses a set of related knowledge, skills and abilities required to successfully perform "critical work and functions" or tasks in a defined word setting.

The center of education and research development, [CERD],(2002) had identified the evaluation criterion of the Biology official exam in Lebanon, which depends on competencies and thus include specific action verbs to measure each competency, which are derived from Bloom's taxonomy.

Based on (CERD, 2000) such action verbs[1] are classified under four domains: Mastering acquired knowledge, practicing scientific reasoning, Mastering experimental techniques and communication. Where each domain includes different competencies that include the corresponding action verbs.

Domain A: Mastering acquired knowledge includes two competencies: Apply acquired knowledge in similar situation (A_1) and Relate the knowledge to new given (A_2).

Domain B:Practicing scientific reasoning which includes eight competencies: Pick out information by analyzing a text(B_1),logically relate information in order to explain(B_2),pose a problem(B_3),formulate a hypothesis(B_4),test a hypothesis(B_5),deduce the result(B_6),elaborate a synthesis(B_7) and show critical thinking(B_8).

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[1] The skills under study is sometimes referred as action verbs in the coming research, since the term "action verb" is frequently among teachers and to avoid repeating the term skills throughout the study.

Domain C: Mastering experimental techniques includes two competencies: perform an experiment or a dissection by following an experimental protocol (C_1) and use adequately the laboratory material (C_2).

Domain D: Mastering communication techniques includes two competencies: use the mean of scientific representations (D_1) and use an adapted scientific language (D_2).

The exam includes exercises covering the three domains of competencies and 70% of the program. Each subject covers one or several themes. Such subjects (4 in case of grade 12 life science section and 3 in case of grade 12 economics & sociology and humanities sections as well as grade 9) are independent and are meant to test the competencies of three domains. Hence the exam includes knowledge and methodological capacities.

 And thus each action verbs has its own requirement to be taught in order facilitate for the student the way for answering and thus unite the bareme of Biology exams.

Thus it's the teachers' duty to find an effective strategy that goes hand in hand with the bareme that is employed to teach the requirements of each action verb.

A new strategy of learning that permit students to do at home lower levels of Blooms and higher level (for example inquiry) are now done in class is the flipped learning. At home students participate in preparation work including watching videos, PowerPoint's, and completing readings. After completing the preparation work, students arrive in class ready to start solving problems, analyzing text, or investigating solutions.

All of the materials needed (videos, power points...) for the flipped learning is either collected by the teacher from different e-sources (Google, YouTube) or prepared by the teacher himself.

2.2 Historical overview of flipped learning

As far back as 1981, video based lectures in higher education were suggested to help or, in some cases even out-perform in-person lectures (Cohen, Ebeling & Kulik, 1981), yet their adoption in higher education has been sluggish until recently.

"Nearly 10 years later, researchers such as Eric Ma-zur (1991) began emphasizing the integration of computers and other technologies into the teaching process. Mazur claimed that, eventually, computers could be tough to help teach and would become an integral and dynamic tool for improving the quality of education". (As cited in Newman, Kim & Lee, p54).

Before flipped classrooms, distance education used educational videos to present content. In 1995, with the emergence of an online content management system, Baker was capable of placing lecture notes online, stretch out classroom conversations and manage online quizzes (Strayer, 2007).

In 2000, Baker (as cited in in Ahmed and Ouda, 2016) introduced the concept to conferences between 1996 and 1998, and started to mention to the method as "The Classroom Flip".

In 2001, Massachusetts Institute of Technology (MIT) took the first step by designing Open Course Ware or Open Educational Resources (OER) and providing learning resources such as text books and videos;

In 2006, Salman Khan as the alumnus of MIT continued the program of MIT (Open Course Ware) with the establishment of Khan Academy; he provided more than 3200 videos from different fields of study for free online access (Bishop & Verleger, 2013).

In 2007, two high school teachers in Colorado, Jonathan Bergmann[2] and Aaron Sams in Woodland Park, Colorado in 2007 (Bergmann, 2011) developed the contemporary method of exploitation of online videos to flip education. Bergmann and Sams were searching for a technique or approach to provide lectures to their students who missed classes because of any accepted reason Jon Bergmann recalls:

"In the spring of 2007 Aaron was thumbing through a technology magazine and showed me an article about some software that would record a PowerPoint slideshow including voice and any annotations, and then it converted the recording into a video file that could be easily distributed online. As we discussed the potential of such software we realized this might be a way for our students who missed class to not miss out on learning. Thus, we began to record our live lessons using screen capture software. We posted our lectures online so our students could access them. When we did this, YouTube was just getting started and the world of online video was just in its infancy. In all honesty, we recorded our lessons out of selfishness. We were spending inordinate amounts of time re-teaching lessons to students who missed class, and the recorded lectures became our first line of defense". (p.1)

In March of 2011, Salman Khan used the term "flipping the classroom" in his TED[3] talk (Khan, 2011). Since that point, interest in the flipped model has grown exponentially with new articles, press, and blogs on the flipped model appearing almost daily. This has generated a brand-new perception in education.

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[2] **Jonathan Bergmann**. **Jon** (**Jonathan**) **Bergmann** is a chemistry teacher and one of the developers of the "flipped classroom" model of teaching along with fellow chemistry teacher Aaron Sams.
[3] **TED** is a nonprofit devoted to spreading ideas, usually in the form of short, powerful talks (18 minutes or less). **TED** began in 1984 as a conference where Technology, Entertainment and Design converged, and today covers almost all topics — from science to business to global issues — in more than 100 languages

Bergmann and Sams started a non-profit Flipped Learning Network (FLN) in 2012. It is known as the FLN which is a free website offering information, resources, and what one needs to know when flipping a classroom.

In May, 2013, the network has over 16,000 members all over the world (Overmyer, 2013). This network presents both pedagogical and best-practice consultation and discussions, in addition to practical and pragmatic support on technology and implementation. Recently, Students grew up on new media technologies are no more enduring filling out worksheets and listening to lectures (Collins & Halverson, 2009). With developments in internet and communications technology, it turned out to be effortless for educators to present active and energetic multi-media educational resources and the proficiency to assist and enhance both content and assessment between instructors and learners. Cloud computing and services such as YouTube, Teacher Tube, and Screencast.com make the distribution and circulation of video resources growing and become easily reached for all educators and students. Technology educators forecast that within a few years, tablet PCs, laptop computers or smartphones with wireless Internet will be carried by almost all students (Levy, 2010).

2.3   Learning theory of flipped learning

In their study, Bryant, Kastrup, Udo, Hislop, Shefner and Mallow (2013) described learning, based on the constructivist theory, as a process of establishing a link between the new information and the information that exists in individuals, during this process. "The individual establishes the basis of information by adding his own comment. By this aspect, teachers have an important role in the constructivist approach in which the core of learning system is the learner. With this approach, teachers do not directly transfer the

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information to the students; but they guide and help learners to reach the information and to construct it". (As cited in Ayaz &Şekerci 2015)

Thus the flipped learning based on the study of Kim & Bonk(2006) can be backed-up by the constructivist theory that necessitates the communication and the collaboration of the learners during knowledge construction,(as cited in Khadri,2016,p 429) which matches the 4C's[4], "super skills" for the 21st century.

Social constructivism in classroom suggests altering educator's role to instructor that guides the student. Thus the roots of flipped learning lies in social constructivism, as Jarvis (2014) mentioned in his study, since the role of the teacher changed from "sage on the stage" to "guide on the side". In addition such learning supports students build their interpersonal communications which will deeply involve them to problem solving, active learning, and inquiry learning.

Accordingly such knowledge construction through communication with their peers during flipped learning supports students to construct at alone new knowledge that is required to be connect to past learning, before coming to class.

In his study, McLeod (2010) discussed that the foundation of social constructivist theory is based on a Vygotsky's "Zone of Proximal Development" (ZPD). And this perspective agrees with the philosophy of the flipped learning, where the teacher, in a flipped classroom, must put the constructivist theory into practice by enhancing the students' metacognitive skills[5].

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[4] 4Cs: communication, collaboration, critical thinking and creativity.
[5] Metacognition is the process of thinking about thinking. It is the process of developing self-awareness and the ability to self-assess. It is contemplation about one's education and learning -- past, present, and future. Since adults are largely self-determining, helping them develop metacognitive skills is an essential element in any program intended to increase their autonomy.

2.4 Description of flipped learning

The flipped learning network (FLN) defined the flipped learning as a pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter.

The (FLN) had listed four pillars for flipped learning which matches with the 21rst century skill, which are flexible environment, learning culture, intentional content, and professional educators. If these four pillars are present, then we can be confident that we have implemented this approach.(www.flipped learning.org)

Flexible environment: Tools and resources, whether technology-based or not, may be custom designed or created by others for use in the blended setting to promote the language communication as the intended outcome. The physical elements of an effective teaching/learning equation support the methodology to promote flipped learning and provide the space for it.

Learning culture: According to Honeycutt and Garrett (2014), "the true essence of the flip is really to focus on the student." Teachers need to consider the type of learners present in a classroom and their socioeconomic status, personalities, cognitive abilities, and language proficiency, as well as facilities available in/outside the classroom in choosing an instructional methodology.

Intentional content: The teaching, lesson, and assessment plans are to maintain a supportive yet dynamic relationship, focusing on planning the before-class and during-class activities, as well as the learning act. The teacher intentionally selects content for the out-of-class

portion and leverages that content for the in class portion in a seamless flow that fosters connections between the students and what they are learning.

Professional educator: Teachers should know the teaching material and their students in order to develop a plan to move learners forward, scaffold activities, and facilitate rather than control learning. Thus, they must be confident planners, managers, guides, facilitators, mentors, coaches, challengers, teachers, assessors, discussants, problem solvers, researchers, and practitioners

Talbert 2014 (as cited in Tanner & Scott 2015), listed different characteristics for an effective flipped classroom, which matches to a certain extent the four pillars of flipped learning. These are:

1. *Highly structured pre-class assignments* which are geared towards introducing the students with the new theoretical concepts.

2. *Means of accountability* to ensure that students complete the required pre-class assignments and out-of-class work.

3. *Well-designed sense-making activities* for the students to engage with during lecture time.

4. *Open-Lines of communication* throughout the course so that students can interact freely with the instructor it doesn't mean that you never explain in class.

Chapter 3
Review of Literature

3.1   Introduction

Flipped Classroom is a new trend of providing and delivering learning through applying ICT. The main premise of this new trend is to share learning responsibility and ownership of learning between learners and instructors. It helps in personalizing learning. "Flipping the classroom establishes a framework that ensures students receive a personalized education tailored to their individual needs and learning styles" (Bergmann & Sams, 2012, p. 6).

Iren and Brownm's study (as cited in A. Abdel Aziz, 2014) mentioned that learning is the driving force for the future. Current learning model is facing a paradigm shift in its content, delivery methods, and assessment techniques. This shift is occurring because of the increasing demand on Information and Communication Technology (ICT) and media network applications.

Ash' study described the term flipping as the idea of swapping homework for classwork. When students go home to work on homework, some of them have well educated parents that can assist them with the work while others have parents that are not knowledgeable in the content and cannot assist them with their homework. (as cited Schmidt & Ralph, 2016). He also mentioned that through such strategy students are able to return to class with the content and then receive assistance with the homework from the expert in the field –the teacher during class time. Thus, the flipped classroom provides the students with in class support for completing work and with more time for hands on activities and content inquiry and analysis easily catch up but do not miss out on vital lectures.

Halili and Zainuddin (2015) noted that "the flipped classroom or reverse classroom is an element of blended learning, integrating both face-to-face learning in the class through group discussion and distance learning outside the class by watching asynchronous video lessons and online collaboration.

3.2   Flipped learning and inquiry based learning

Love and Ernst (2016) clarified that Inquiry based learning (IBL) and the flipped classroom are natural partners. "Students in a flipped class encounter the course content outside of the classroom. This frees up class time for other activities that can enhance the learning of the content. IBL is a perfect instructional practice to use for this freed-up time."

In addition, we agree with Jenkins, Bokosmaty, Browne, and Hanson, (n.d) that concluded that "Flipped learning pedagogy stems from the premise of inquiry-based and egalitarian philosophy: In the new reality, teachers have acquired a new role: that of mediator, helping students transform the information that can be easily accessed into knowledge.

This requires that students be active and engaged participants in their learning process and teachers be facilitators in the process. In the flipped learning environment that we advocate, the traditional role of students as passive recipients of knowledge is substituted by their active search for information followed by the process of analysis, negotiation of ideas, and subsequent transformation of information into knowledge. As it fosters student participation, flipped learning potentially increases their responsibility, creating a community of learners who, through collaborative work, are responsible for each other's learning and form a community of inquiry"(p. 10).

Moreover the Flipped Classroom has a comprehensive instructional model that includes direct instruction, inquiry, practice, formative and summative assessment and many more

elements (Bennett, et al. 2011). These instructional techniques give a focus to the process of learning. It is aimed to enable students to be more actively engaged with the course material and, ultimately, empower them to construct knowledge through their understanding.

Finally according to flipped classroom instructor Ramsay Musallam, when flipping his classrooms to achieve meaningful student learning, he would include the "Explore" phase, where students would work through guided inquiry exercises. This is based on the Explore-Explain-Apply inquiry learning cycle developed by Robert Karplus (Musallam, 2013). The in-class instruction merged aspects of blended learning with an inquiry-based learning cycle. (As cited in Danker, 2015).

3.3   Flipped learning and Bloom's Taxonomy

Ahmed and Ouda (2016) mentioned that flipped learning permits a student to attain a substantial basis of a topic, the understanding, before a session, in order that other activities, assessments and consolidation activities can build on the developing the higher skills when a teacher is present to support the student. This can be compared to the traditional method of teaching where the basic level skills are often the center of attention of classroom sessions and students are left to work on the higher levels skills in their own time with homework and additional exercises. Thus students through flipped learning , are doing the lower levels of cognitive work (remembering and understanding) outside of class, and focusing on the higher types of cognitive work (applying, analyzing, evaluating, and creating) in class, where they have the encouragement of their peers and instructor. Lankford (2013) mentioned that the flipped classroom focuses on how to support the learners in achieving a higher level of the taxonomy domain. Additionally, Nederveld and

Berge (2015) added that in flipped learning, classroom activity is spent on application and higher-level of learning rather than listening to lectures and other lower-level thinking tasks.

3.4   Benefits of flipped learning

3.4.1   Motivation & learning on their pace

Motivation is the word derived from the word 'motive' which means needs, desires, wants or drives within the individuals. It is the process of stimulating people to actions to accomplish the goals. In the work goal context the psychological factors stimulating the people's behavior.

There are two types of motivation, intrinsic and extrinsic motivation. Intrinsic motivation means that the individual's motivational stimuli are coming from within. The individual has the desire to perform a specific task, because its results are in accordance with his belief system or fulfills a desire and therefore importance is attached to it.

Extrinsic motivation means that the individual's motivational stimuli are coming from outside. In other words, our desires to perform a task are controlled by an outside source. Note that even though the stimuli are coming from outside, the result of performing the task will still be rewarding for the individual performing the task.

Many studies showed that the impact of applying the flipped classroom was to increase students' motivation in relation to learning activities. For example, Davies's study (as cited in Zainuddin & Halili, 2016) mentioned that students were able to learn based on simulated learning and that they were motivated to learn at their own pace; they also noted that the students wished to recommend the flipped classroom to their other friends.

In addition in their study McLaughlin et al.(as cited in Zainuddin & Halili,2016) also discussed that flipped learning can be implied that learning environments created by the flipped classroom approach are likely to satisfy students' needs for competence, autonomy, and relatedness and, thus, entice greater levels of intrinsic motivation".

Newman, Kim, Lee, Brown, and Huston 2016 found that for students who completed the flipped course assignments on time, the self-paced approach slightly increased stimulation; Where flipped teaching was primarily helpful for those students seeking courses which allow them to learn at their own pace. "A majority of the students (55.2%) agreed motivation to learn in the flipped classroom increased and 84.7% enjoyed the self-pacing capabilities of the flipped material. However, 12.6% did appear to be de-motivated by the approach." Newman et al. (2016) revealed that self-motivation of students was increased because students had the chance to stop materials whenever they want.

Tanner & Scott (2015) mentioned that it was also perceived that the quizzes motivated students to read the course material before the lecture.

"This extrinsic form of motivation stemmed from the requirement of students to complete 80% of the quizzes to be allowed to participate in the final exam".

3.4.2   Engagement & Achievement

In education, students' engagement is acknowledged as one of the most crucial elements which support students' performance and achievement.

In their study Tanner and Scott (2015) mentioned how beneficial was the discussion held in class because students were engaged in the teaching-learning process and were able to understand the concepts easily. In addition they felt that the exercises, in combination with

the discussions, were perceived to be more effective than traditional lectures and better contributed to learning.

Similarly ,such benefit what was discussed Tucker's study 2012(as cited in Newman, Kim & Lee, p 54), in which in a flipped teaching provides instructors the ability to spend more time to interact with their students that need increased assistance(low achievers) and while allowing them to be engaged more on class.

Accordingly, in their study Huang and Chiu (2015) mentioned that flipped classroom in education enhance student learning and achievement by focusing class time activities on student understanding and hands-on activities rather than on lecture. They discussed also that some teachers have implemented the flipped classroom model to examine students' achievement in learning various subjects. For example Talbert (2014) said "to date, the approach has been used in a variety of fields of studies including Biology, Engineering, Physics, Statistics, Mathematics and Computer Science. (as cited in Tanner & &Scott 2015).

In their study, Zainuddin and Halili (2016) clarified that the flipped classroom model has effectively supported students' learning achievements with several motives since students learnt from the mistakes that were pointed out to them during the class discussion and the formative feedback. Some of them even felt that most of the learning occurred during these exercises. Learning by doing was valued and being able to try out the exercises themselves enhanced their learning experience which was perceived as a benefit by the students.

3.4.3   Budget constraint

 (Schmidt & Ralph, 2016) discussed that budget constraints is not an obstacle for a teacher from flipping his classroom. According to Fulton's study (as cited in L.Ralph, S. M. 2016

p 2) discussed among the three different scenarios, to implement the flipped classroom, is what happened in Minnesota high school, when Math teachers decided to flip their classroom although they had a severe budget constraints .They first used YouTube to store videos to accompany materials they created and implemented themselves. Then because of the expensive course management system, they turned into Moodle a free online learning management system, where it can be used to store documents, videos, and information for students.

Moreover a successful   exclusive offline flipped classroom that was implemented by an elementary teacher also proved that the budget constraints of using technological tools while flipping can be easily handeled. Where he was very creative in assigning home works for his students at this level, by asking them to use colors! He asked them, while completing the reading, to highlight key points in one color, new vocabulary in another color and confusing or points that need clarification in another color. Other times students were asked to do notecards for specific information.

In both models all of the teachers attained their objectives which proves that it's the way the teacher manages his class.

Moreover Norman (2015) discussed that economics instructors that shifted to flipped learning had used free materials like downloading videos to be used as flipped course or using a free software like "jing" instead of using somehow expensive software like "Camtasia," has by far the most features and costs $179.00 for a single user license .Moreover concerning exercises to be solved in class, he mentioned that those instructors had used already prepared exercises after converting them into pdf .

3.5   Draw backs of flipped learning

3.5.1   Difficulty of stimulating students outside class   learning styles

Most of the students had experienced the flipped classroom for the first time and such

experience may be difficult for them to learn by their own the lesson for the first time and

that's may create a negative impact toward such course which demotivate them to be

enrolled with the flipped class in another course.

Tune, Sturek, and Basile (2013) mentioned that it is difficult to stimulate students outside

the class.

 "Although online materials have been shown to increase enthusiasm in some cases (be-

cause they are different than some traditional drab lecture techniques), students can have

difficulty being self-motivated from studying alone at home without the professor present

and can become easily dissatisfied".

Flipped learning is not solution to manage the problem of missed homework by some

students, since in their study Schmidt and Ralph (2016) mentioned that there exist students

came to class without their home works which made such teacher to claim that the flipped

classroom is not the solution for incomplete home works.

3.5.2   Inability to be self- learner

The inability to be self-learner through flipped classroom was discussed by Martin (2012)

in his study." Students, just like anyone else, can sometimes be resistant to change,

regardless of improved outcomes which can result in lower perceptions for newer teaching

models".

In addition Tanner and Scott (2015) mentioned, in their study that some students were not

able to understand the prescribed material, thus making solving the exercises difficult and

thus don't gain the needed benefit.

Moreover Tanner and Scott (2015) clarified that some students weren't able to follow in with the classroom discussion, consequently they became somehow distracted leading to disengaging of such minority.

Talbert (2012) finds fault with the method because he uncovers students' feelings of being alone in learning with a form of cultural shock at this opposite way of participating in a classroom.

In addition, instructors also faced some problems in practicing flipped learning, as more time would be spent on designing good content to ensure students were motivated to watch the lecture before coming to class. Especially, if teachers are not experienced enough with the flipped learning, consequently poor quality of video usually became a common problem in flipped classroom practice. (Milman, 2012).

 Similarly,in his study Enfield (2013) also stressed that if the content and design of a video lecture is unattractive, the students will find it tedious to watch outside the class, thus students won't gained the expected benefit of the flipped learning.(as cited in Zainuddin and Halili,2016,p332).

3.5.3   Not all learning styles are matched

 Based on North Carolina Professional Teaching Standards [NCPT] (2013), (as cited in Khadri, 2016, p 434), flipped learning doesn't satisfy all of the learning styles of the students. Especially that not all teachers accept to adjust their teaching strategy during flipping to match such styles. Accordingly, new responsibilities were proposed by NCPT if the teacher decided to flip his classroom:

"Embracing diversity, individualizing instruction to include differentiating instruction based on student interest, learning styles, and social and emotional development of their

students; collaborating with their colleagues; and, utilizing technology to help student's

access content, to learn how to think critically, solve problems, communicate, and

collaborate".

Chapter 4
Methodology

In this chapter, the design of the study is discussed along with the variables. Information about the school in which the intervention took place is given along with information about the chosen sample. In addition to that, the procedure that was followed, the instruments that were used and the data analysis are provided.

4.1 Sample

The sample consists of the Biology teacher that conducted the research and of the grade 11 class (scientific section), of 27 students at a private school at Ras El Nabeh (Beirut). Eleven of them are males and sixteen of them are females. Their ages ranges between 15 & 16 years. The class as a whole is considered as good class having an average of 14.03 over 20.Usually only one student fails. They seek to learn more and there is a spirit of challenge between the high achievers students which represent 37% of the class (10/27). Finally the language of Biology instruction is English.

4.2 Instruments

4.2.1   Pretest

 Before the intervention a pretest was prepared which measures students' achievement in Biology in general and in the two action verbs under study specifically. Sixty minutes were assigned for such pretest that is scored out of twenty. It includes three exercises scored 6/20, 6/20 and 8/20 respectively. In addition every exercise included questions that begins with a specific action verb which matches the evaluation system of Biology official exams in Lebanon.

4.2.2   Materials for flipped learning

Before the intervention, three animated power point presentation were prepared by me using office mix [6].

Such presentations explain transcription process, tools of translation, and stages of translation respectively. Such presentations were sent separately to students to serve as the needed material for flipped learning at home.

The first and the third presentation explain the stages of transcription and translation respectively which are initiation, elongation, and termination, and the third presentation explains the tools of translation. Unlike tools of transcription that were deduced after knowing its stages, the tools of translation must be explained before explaining its steps since they control the order of protein synthesis, because of this two power point presentation were prepared for translation.

In the first power point presentation a photo of a book containing recipe for spaghetti was used as an analogy for information found in deoxyribonucleic acid (DNA) in the nucleus, that will guide me to cook the desired spaghetti thus to synthesize the desired protein. Moreover the last part of the third power point presentation included a real uncooked spaghetti to relate information with the first lesson.

 In addition it was clarified that the starting point in translation is the initiation codon instead of promoter and the ending point is the stop codon instead of terminator.

 Also a brush was used in the second presentation and wrote on it codons while explaining the genetic code table. In addition I tend to talk in non-monotone way accompanied with facial expressions so as to make students more motivated while watching and feel that they

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[6] **Office Mix** is a powerful free Microsoft add-in for PowerPoint 2013 designed for businesses, educators, and students to easily create and share interactive online presentations.

are more effective than you tubes videos. That is to say I tried my best to make such

presentations interactive instead of having the "chalk and talk" teaching style.

Finally it is important to mention that the content for gene expression was collected from

my previous notes   but updated, using online sources, to make it easier for self-learning.

4.2.3   Activity sheets

Three activity sheets were prepared as an application for each of the knowledge learned

from the three power point presentations that were discussed briefly before. Each activity

sheet includes set of questions organized from easiest to hardest which do not only allow

students to directly apply their knowledge but also relate what they learned before with

what they have learned now. For example in activity sheet 1 students were asked to

compare between DNA (that they learned before) and RNA (that they learned from lesson 1

through flipped learning) and this belong to higher level of Bloom's taxonomy.

It is important to mention that activity sheet 3 includes a protein flow chart which enables

student to wrap up briefly what they have learned about gene expression as a whole.

Moreover most of the questions were taken from online sources and modified in such way

it matches the students' cognitive level in each lesson, and some of them were prepared by

me, where I relied also on previous exams I did before.

Although the principle of flipped learning relies on solving in class and learning at home,

but I insisted to make my student solve a revision sheet (Easter vacation sheet) since my

intervention was interrupted by Easter vacation and I wanted them to review what they

have learned. Where I used it later as a formative evaluation to their previous knowledge

since as it was mentioned before it was corrected by students then by me, then I compared

both grades as shown in table 3 in the appendix, where 11 students gave the same grades I

gave and the majority gave a close grade to my grade, which means that they were aware of

their learning and they somehow mastered the content which made me satisfied with the

outcome of flipped learning.

Finally, since the intervention was interrupted by an Easter vacation, an activity sheet was

prepared in order to make them review to what they learned during such vacation. Such

Easter vacation sheet includes 14 questions, 8 of them are related to transcription only

(questions 1,2,6,8,10,11,12 & 13) which make students review essential ideas related to

such lesson. Questions 3 & 5 include simple comparison between transcription and

translation. Finally two questions (4 & 14) are related only to some tools of translation

which are the different types of RNA.

4.2.4   Handouts

Two handouts were prepared for each action verb. Each handout includes a definition of the

given action verb, checklist for solving such action verbs correctly and set of questions to

practice on solving such action verbs. Such questions were collected from previous official

exams with some modifications.

Moreover, only in Handout 2 there exist , in addition to what was listed before, a

description about the types of hypotheses as they are included in the previous official

exams.

4.2.5   Questionnaire

It is a set of ten statements collected most of them were collected from an online sources

and the rest were prepared by me. Three of them reflect negative ideas related to flipped

learning (statements 4,5&6) , two of them compare the flipped learning to the traditional

learning (statements 3 & 7),four of them describes the flipped learning (statements 1,2,8

& 9) and finally the last statement measures whether the students wish to continue with flipped learning or not. Each statement had three Likert scale choices, agree, neutral & disagree, scored 1, 2, &3 respectively, except the negative questions the scoring was reversed, 3, 2 &1respectively.

It is important to mention that such questionnaire was pilot tested before introducing it to my sample after the intervention.

4.2.6   Posttest

After the intervention a sixty minutes posttest, like the pretest, were done also of three exercises scored as 5.5/20, 7/20 and 7.5/20 respectively. In addition it includes an exercise related to gene expression that was not included before.

Concerning validity and reliability of the instruments used:

- ✓ Both pretest and posttest were supervised by my Biology coordinator.
- ✓ The first animated PowerPoint for flipped learning was pilot tested which made me modify in it
- ✓ Checklist for schematizing was prepared based on the researcher's teaching experience, whereas checklist for formulating a hypothesis was taken from page 12 of the latest version Biology guide (To succeed in Bac, version 2016) which is prepared by two members of Biology committee, and a doctor. Moreover both checklists were supervised by seven Biology coordinators that have more than ten years' experience in teaching.
- ✓ Questionnaire before being administered to my sample it was pilot tested by the researcher where statements 4, 9 & 10 were modified to be clearer.

4.3 Research design

 The research design was an action Research which is a disciplined process of inquiry conducted *by* and *for* those taking the action. The primary reason for engaging in action research is to assist the "actor" in improving and/or refining his or her actions.

And through such action research the main target was to improve two skills among the different skills on which the evaluation system in Biology depends on, accompanied with teaching them the needed content in which will be both measured after the intervention and compare it with their achievement before the intervention.

4.4 Procedure

The study conducted took seven weeks, divided between Fridays (2 sessions) and Wednesdays (1 session). As a brief overview ,at home students were asked to learn Biology new concept from the teacher's animated power point presentation accompanied with researching for difficult ideas that they didn't understand (guided inquiry),and at class students applied their knowledge related to each concept by solving application exercises in addition to practicing on the mentioned skills.

 The study was divided into two phases, phase one was the preparation phase, and phase two was the implementation phase.

 During phase one:

First it is important to mention that as it was described in the review of literature by Brame (2013) that the flipped learning principle is that students are doing the lower level of cognitive work (remembering and understanding) outside class, however focusing on the higher types of cognitive work (applying, analyzing, evaluating, and creating) are done in

class. Accordingly the chosen skills are of higher level of Bloom's taxonomy. Thus the intervention done typically matches with the principle of flipped learning.

Moreover all of the instruments that were discussed before were prepared. In addition to the 5E[7] lesson plan (see appendix) for the whole gene expression theme that included flipped learning as a teaching strategy. Moreover a brief course that explains what is meant by flipped learning, brief explanation of the scientific method (including experimental protocol of self-inflating balloon and the definition of a hypothesis and characteristics for a good hypothesis) and Biology notes related to digestive system and nervous system as a background knowledge needed to formulate a hypothesis that may explain a certain result or phenomenon were prepared.

During Phase Two:

As a general overview, during the coming sessions, the major class time was invested in practicing on the mentioned skills through solving application questions of the handouts, and applying their knowledge related to each lesson by solving activity sheets; and the minor class time was invested to discuss the lesson they were taught at home previously through flipped learning.

After planning was completed, phase two started. On Friday March 17th, students did the pretest which was followed by another session for correcting it with the students.

Accordingly during the third session the principle of flipped learning was explained in brief based on well prepared course presented as PowerPoint (see appendix p.11) followed

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[7] The 5 E's is an instructional **model** based on the constructivist approach to learning, which says that learners build or construct new **ideas** on top of their old **ideas**. ... Each of the 5 E's describes a phase of learning, and each phase begins with the letter "E": Engage, Explore, Explain, Elaborate, and Evaluate

by explaining, based on the prepared lesson plan, what is meant by gene expression in order to introduce the terms "transcription" and "translation".

Concerning the action Verb Schematize a textual document:

During the fourth session students received handout #1 followed by explaining for them what is meant by a checklist and what they are supposed to do in every step. Then they were given around twenty minutes, to work individually, and try to apply such steps in order to schematize the first document.

While students were solving, individually, I was turning around and helping students in applying any step they found it unclear. After that the first document was corrected to end up with a common schema. Finally students' schemas of the first document was collected in order to be corrected later to identify whether they were able to apply such steps easily or not and to share later with them the common mistakes.

Two sessions were invested to practice on the action verb schematize before flipped learning. However before practicing on schematizing a textual document for the second time, students' mistakes were discussed (see appendix) followed by repetition of the steps of the related checklist that was previously explained.

At the same time the first power point presentation explaining the stages of transcription, was pilot tested with my students, of the same class, at a public school. Thus my sample received Wednesday March 29th an updated power point presentation related to lesson 1 "transcription" and they were asked to give me their notes of what they learned and any feedback on Thursday. The pilot study was very important to be conducted since it made to prepare a highly structured content able to introduce students to new theoretical concepts and that is one of the characteristics for an effective flipped classroom proposed by Talbert (2014).

Accordingly the students' time at home was somehow managed although they were learning on their pace, because they were obliged to deliver their notes on a specified deadline.

After watching each presentation and prior discussion of the lesson in class, students delivered their notes they have learned so as I was able to know the cognitive level of each student and identify any misconception related to any idea. For example I was able to detect a misconception related to hairpin loop of RNA[8] that is formed by the end of transcription.

Following discussion of transcription process activity sheet #1 was solved accompanied with practicing on schematizing a textual document for the third time.

Three sessions, before the Easter vacation, were devoted to make students skillful in schematizing a textual document.

And here it is important to mention that since students solved individually at home the Easter vacation sheet I asked them when they are in class to switch papers so as each one correct the other's sheet which will be followed by my correction, where comparing mistakes will be served as direct formative assessment to what had learned before such vacation.

Concerning the action verb formulate a hypothesis:

Teaching students how to formulate a hypothesis took more time since it was preceded by explaining of the steps of the scientific method and types of hypothesis. After conduction the self-inflating balloon experiment the steps of scientific method were explained, based

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[8] Ribonucleic acid, a nucleic acid present in all living cells. Its principal role is to act as a messenger carrying instructions from DNA for controlling the synthesis of proteins, although in some viruses RNA rather than DNA carries the genetic information.

on the experimental protocol prepared as power point presentation, which include

formulating a hypothesis in the second step. After explaining what is meant by a

hypothesis and emphasizing that is an educated guess which is important in order to avoid a

"blind research", the types of hypotheses, based on previous official exams, were explained

by referring to handout #2.(see appendix)

 Where I focused on targeting my students practice on formulating the second type that

relies on their acquired knowledge, since based on my experience students face problem in

relating what they know with a new situation.

Accordingly certain knowledge were needed to be built in order to be able to formulate

such type of hypothesis. Such topics which are included in the second handout which are

related to digestion and nervous system. Questions related to these two topics were chosen

on purpose where they are not hard for grade 11 students since they learned about digestion

in grade 9 and about nervous system in grade 10, consequently no difficulty was faced

when there was recalling of such topics. (Students received a hard copy of the notes related

in order not to waste class time while copying information needed only to solve and not to

memorize).

After around 10 sessions of the intervention, the whole theme of gene expression was

explained and all of the activity sheets related were solved as well, in addition I have ended

up with training my students on schematizing and practicing for the first time formulating

a hypothesis. Accordingly as it was mentioned by the North Carolina Professional Teaching

Standards, (2013) that flipped learning does not satisfy all of the learning styles of the

students. Thus I decided to meet all my students' learning styles and involve the

kinesthetic students in creating a mind map related with gene expression. Where they, with

their classmates, integrated art in Biology. Each group brought their own crafts in order to

design their map. Such session was followed by three sessions for practicing on

formulating a hypothesis.

Finally during the last session students reflected about flipped learning by filling the

corresponding questionnaire followed by solving the post test.

4.5   Data Analysis

 Students' grades of the pretest and the post test (including grades taken on the studied

action verbs) were collected and compared. By this six variables were obtained. In

addition after scoring the questionnaire as mentioned above, students' responses were also

collected.

The data was collected then organized using SPSS software. Such data was analyzed using

descriptive statistics which included quantitative analysis only.

As a general overview, the grades of the pretest and the posttest were compared which

reflects in general their achievement, then specifically I compared their achievements in the

studied action verbs, which is scored 5 out of 20, after calculating frequencies and

measuring regressions between specific variables. Accordingly it was relied on students'

grades for quantitative analysis whereas qualitative analysis was performed based on

students' responses in the questionnaire.

Chapter 5
Results

This chapter includes the results obtained using the instruments discussed above. The main purpose of this study is to determine the effect of flipped learning on students' achievement.

Students' achievement in Biology as a whole and on their acquiring the needed skills were assessed using a posttest which relies the evaluation system in official exams as mentioned before. Moreover students' reflection toward flipped learning was assessed using a ten statements questionnaire.

As it was discussed before that such study relies on two research questions.

Concerning Research question 1:

Does being a high achiever in Biology rely mainly on understanding the requirements of specific higher ordered skills?

As it was clear in the pretest that action verbs under study were scored five over twenty and by comparing students' grades taken in such action verbs with the total grades we observe that there is a great influence of mastering such skills on their achievement as a whole.

The total competency represents the total grades taken on the hypothesis (2/5) and the total grade taken on the schematize (3/5).

Table 1 allowed us to make a brief comparison between students' achievement before and after the intervention.

Student's number	Total competency out of 5 (pretest)	Total grade out of 20(pretest)	Total competency out of 5 (posttest)	Total grade out of 20(posttest)
1	0.5	9.5	5	15
2	0	8.25	2.5	13.5
3	0.25	9	3	14.25
4	0.25	10.5	5	16
5	0	8	3	13.75
6	0	6.5	5	17
7	0	1.25	4.75	18.75
8	1.5	13.25	5	16.5
9	1.5	9.5	5	16.5
10	0.5	8.5	5	14.5
11	0.25	4.75	0.5	11.25
12	0.25	8.25	2.5	14.5
13	0.75	12.75	5	15.5
14	0.5	10.75	5	16.25
15	0.5	9	5	17
16	0.75	13.5	4.75	17
17	0	9.75	0.5	10.5
18	0.75	15.5	5	18
19	0.75	11.5	5	17
20	1	10.25	5	16
21	0	9	5	17.5
22	0	9.75	5	17
23	0	7	5	19.25
24	0	9	5	16
25	0.5	10	5	17
26	0	8	2.5	15
27	0.5	12.25	5	18.5

Table 1 : students' grade on total competency before and after the intervention

As it is clear that most students in the pretest failed in the total competency and, consequently they failed in the test, however after the intervention all of the students succeeded in the total competency except two students and thus 26/27 students not only succeeded in the posttest but also got high grades.

Subject 18 had the highest grade in the pretest (15.5/20) although she failed in the total competency but in the post test she succeeded (got a full mark).

Subject 17 is level one in his class he got 12.25 on the pretest but failed in the total competency, however in the post test he got 18.5,which means he improved by 6.25 grades ,5 of them were taken on the total competency. Which means that high achievers students got benefit from flipped learning to promote their skills.

Subject 12 was absent, he missed 2 sessions of schematizing and lesson 1 transcription

He was only present during translation lesson and during practicing hypothesis. However he succeeded in the total competency and in the post test.

Subject 23, is a middle student, had the highest grade in the post test (19.25), he had total grades on the competency and full grade in domain A, this reflects that acquiring knowledge alone is not sufficient to become a high achiever, it's a combination of two.

In the pretest students' grades were divided among the three ranges : between 0&9.9, between 10 & 13.9 and more than 13.9, more than half the students (59.3%) had their grades within the first range and only 1 student had his grade within the first range. However after the intervention, none of the students had their grade within the first range, which means that none of them failed in the post test but instead 23 student out of 27 had their grades within the third range. Results are shown in tables 2 and 3 respectively.

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid between 0 and 9.9	16	59.3	59.3	59.3
between 10 and 13.9	10	37.0	37.0	96.3
more than 13.9	1	3.7	3.7	100.0
Total	27	100.0	100.0	

Table 2: ranges of students' grades on the pretest

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid between 10 and 13.9	4	14.8	14.8	14.8
more than 13.9	23	85.2	85.2	100.0
Total	27	100.0	100.0	

Table 3: range of students' grades on the post test

Moreover a regression was studied between the total grade taken on the post test

(dependent variable) and the grades taken on the schematize (independent variable). Also

another regression was done between the same dependent variable and with the grade taken

on the hypothesis. Results are shown in tables 4 and 5 respectively, where in both tables

the alpha is 0 which reveal that after the intervention when students became skillful in such

action verbs they became high achievers in biology which assures that understanding of the

requirements of the action controls students' achievement in Biology.

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	10.965	1.155		9.494	.000
	sch for post	1.834	.415	.662	4.418	.000

Table 4: regression results for students' grades on schematize and total grade on the post test

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	13.042	.567		22.994	.000
	hyp for post	1.830	.322	.751	5.692	.000

Table 5: regression results for students' grades on formulating a hypothesis and total grade on the post test

Concerning research question 2:

Can flipped learning be an effective tool to promote students' achievement in Biology?

Students' grades taken on the studied action verbs were collected and divided into ranges before and after the intervention.

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid between 0 and 2	27	100.0	100.0	100.0

Table 6 : Students' grades on the total competency before the intervention

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	between 0 and 2	2	7.4	7.4	7.4
	between 2.1 and 3	5	18.5	18.5	25.9
	more than 3	20	74.1	74.1	100.0
	Total	27	100.0	100.0	

Table 7: Students' grades on the total competency after the intervention

By comparing students' grades in the total competency before and after the intervention it is clear that before flipped learning all students failed whereas after flipped learning 25/27 students succeeded in the total competency where the majority had their grades more than 3 over 5, and only 2 students failed in such parameter. Thus flipped learning was effective time management tool that created a chance for all the students to practice enough on two difficult skills. Thus we can say that flipped learning had an important impact on enhancing students' skills needed in biology. And here it is important to clarify that it is focused on the impact of enhancing students' achievement in Biology by promoting students' skills using a technological tool which is flipped learning. Accordingly the aim wasn't to study the impact of flipped learning as a direct tool on enhancing students' achievement but as an indirect tool that helped the teacher to overcome her problem regarding achievement in Biology.

In addition after the students had learned very well the studied skills a regression between the total grade on the post test (dependent variable) and the difference between the post test and the pretest was done (independent variable) which reveals alpha of 0.013 which is significant assuring that indicating that flipped learning not only had promoted students' skills but also their achievement as a whole in Biology.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	13.388	.996		13.437	.000
	diff	.410	.152	.474	2.688	.013

Table 8: regression results for the total grade taken in the post test and the difference between pretest and the post test.

Moreover as a qualitative analysis students' reflection toward flipped learning was studied through a questionnaire where the percentage of each likert scale choice of each statement was measured as shown in table 9

Statements	Agree (%)	Neutral (%)	Disagree (%)
1. The material prepared for flipped learning (FL) was organized in such a way it facilitated my understanding of the needed information	85	15	0
2. I am satisfied with FL because it made me solve many exercises related	74	26	0

to the lesson more than I used to solve before.			
3. I like FL more than Traditional Lecture.	70.3	26	3.7
4. I faced difficulty while I was studying at home because I was not used to study in advance by myself.	**14.9**	**29.6**	**55.5**
5. It was time consuming while uploading the materials to be studied.	**44.5**	**29.6**	**25.9**
6. Assignments in FL were too much.	**0**	**18.5**	**81.4**
7. FL is less boring than traditional lecture.	88.9	7.4	3.7
8. FL gives the chance for active learning via discussion with friends and question	85.2	11.1	3.7
9. FL gives motivation to study necessary contents by oneself.	85.2	11.1	3.7
10. I want to keep learning through Flipped classroom from time to time.	77.8	22.2	0

Table 9: The percentages of the responses of the different items of the "Assessment of Students' Attitude towards FL" questionnaire

After observing percentages in table 5i it is obvious that students liked flipped learning and considered it as an effective strategy of teaching where 77.8% wished to keep learning through flipped classroom from time to time. However most of the students (44.5) agreed that it was time consuming while uploading materials to be studied and actually I have expected that since we do suffer in Lebanon from bad internet connection.

In addition a regression was done to see whether a relation between students' negative reflection and the grades taken on domain A in the post test.

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	4.831	.621		7.781	.000
	negative questions	.091	.086	.212	1.062	.299

Table 10: regression results between scoring in negative reflection toward flipped learning and students' grades in the post test

As it is obvious from the above table that the negative reflection toward flipped learning of some students didn't affect their knowledge acquisition where the results obtained are not significant (alpha = 0.299).

Chapter 6
Discussion

Through flipped learning more class time were invested to practice on the action verbs under study. In addition students experienced for the first time to be as self-learners and being responsible of their learning in which they were able to apply their knowledge in class. By adopting flipped classroom students became more engaged in the teaching learning process and became much more aware while discussing information of each lesson. Another benefit of flipped learning, that I didn't expect, was students' interaction among each other before coming to class (through the whats up group), they asked each other about different issues passed and I shared with them such conversation which made discussion in class much smoother. It was clear for me that students did not use to know the real meaning of each action verb. Concerning the action verb schematize some of the students translated schematizing as listing the information given as points and most of them missed information given and was not able to use the given legends correctly. Concerning the action verb formulating a hypothesis most of the students had a misconception between posing a problem and formulating a hypothesis, thus they failed in the total competency in the pretest. However such great improvement observed in the post test could be a justification for a serious learning through flipped classroom and a reflection for well-designed materials starting from the content prepared to be learned at home ending up to the suitable activity sheets prepared for each lesson. In addition students were given enough time to practice on such action verbs that I have never experienced before in my class. And this matches with the study of Huang and Chiu (2015) mentioned that flipped classroom in education enhance student learning and achievement by focusing class time activities on student understanding and hands-on activities rather than on lecture.

Being involved in the teaching –learning process and the chance created to apply directly their knowledge in class made students motivated during the intervention especially, as they mentioned in their feedbacks, they were interested by learning in their own pace; that what was also discussed as one benefit of flipped learning in the previous review of literature by Newman, Kim, Lee, Brown, and Huston 2016 who found that for students who completed the flipped course assignments on time, the self-paced approach slightly increased stimulation; Where flipped teaching was primarily helpful for those students seeking courses which allow them to learn at their own pace.

What I enjoyed most is that I was able to overcome one of the drawback mentioned in the previous review of literature which is the inability of flipped learning to satisfy all the learning styles of the students, based on NCPT standards2013, (as cited in Khadri, 2016, p 434), by involving the kinesthetic students while constructing in class a mind map that sums up what they have learned about gene expression by using designs and materials of their own; One of the groups used lollipop as an analogy for transfer RNA in the ribosomal subunit during translation. Others included terms from their own like "see you" as if an alternative for "C: cytosine" and "U: uracil" nucleotides of the RNA. I was happy because all of the groups challenged themselves to be creative!

Finally the table below reflects how aware the students were about their friends' learning when they corrected their Easter vacation sheet almost the same way I have corrected them.

Grades given by the students	Grades given by the teacher
7.5	7.25
7.5	7.25
7	5.75*
6.25	6
7.5	7.25
5.25	5
6.5	6.25
7.5	7.25
7	7.25
7.25	7.5
6.25	6.5
4	4.5
6.25	6.5
5	5.5
5.25	6
6.5	7.25

Table 11:Grades taken on Easter vacation sheet when corrected by students then by the teacher.

As it is clear from table 5k that only one student had an inaccurate correction, and the rest corrected "correctly" which reflects how much they grasped the information. (each question was scored 0.5 out of 7.5 except question 14 was scored 1 out of 7.5).

6.1 Limitation

The limitation in our action research is related to teachers and to the students. Concerning teachers, they must be experienced enough in order to prepare an organized interactive e-lesson clear enough to explain all the needed objectives for the given lesson to avoid any misconception. In addition to be able to follow up with his students prior to class discussion, and prepare efficient application exercises.

Concerning students, it is not easy to control students' learning at home since their capacities differ from one student to another besides they are not familiar with the idea of "self learners".

6.2 Recommendation for further research

For further studies a similar research could be done in different subjects allowing teachers to invest class time for other activities. Accordingly we can create a common platform for flipped learning preparing self-learners ready for a certain extinct, for university studies.

The same study could be carried out for a longer period of time during different classes to make students get used of self-learning by simplifying materials needed based on the class level since students preferred (based on their responses on one of the statements of the questionnaire) to learn from time to time through flipped classroom as shown in Figure 1.
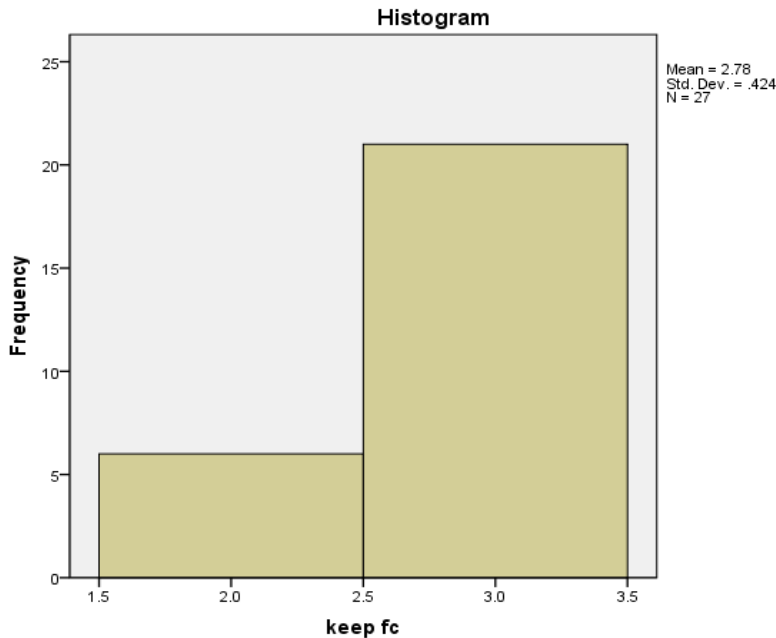
Figure 1: students' response on 10th statement of the questionnaire

Finally, it is also suggested to study a deeper impact of flipped learning on students''

achievement by conducting two groups, first control classroom learning without flipped

classroom and second group ,learning with flipped classroom.

6.3   Conclusion

I once read that students' perception about certain subject affect their attitude in class thus

affecting their motivation toward learning. Accordingly students cannot learn a subject if

they have negative misconceptions about it. Here comes the role of a professional teacher

that must work on one of the major teaching objectives which is treating students'

misconception and prepare educated citizens rather than acquiring them only knowledge.

 In such digital age, teachers are no more source of information!

However at the same time we cannot ignore the importance of making students high

achievers in the subject we teach thereby preparing well for the official exams.

To be a high achiever in Biology doesn't rely only in being knowledgeable with scientific information but also to be skilful in certain skills, thus matching the accurate bareme of the official exams. Thus teaching Biology matches the objectives mentioned before.

Based on my teaching experience I faced the negative misconception of the students toward Biology since there grades don't matches their expectation. Where a common misconception was built among them in different classes that as much as you study Biology you won't gain high grades; this created a negative attitude toward students which targeted more number of grade twelve students in the school I teach to choose the general science section instead of life science section because they guarantee high grades in the Math and physics more than Biology thus they guarantee high achievement in the official exams which may offer them scholarship in the university.

This motivated me to solve such problem starting from identifying its roots. As a Biology teacher for grade twelve, life science section, I don't have enough time through the academic year, which is 7 months instead of 9 months excluding Christmas vacation and Easter vacation, to train my students enough on all of skills needed since I have a huge content to cover and I consider, like other teachers, that students are supposed be trained enough on such skills during previous classes. However what is happening in my school was the lack of coordination among Biology teachers at the intermediate and secondary level. In other words the skills that are taught before are not taught with the same accuracy and toughness in grade twelve in addition that some skills are not taken into consideration which are formulating a hypothesis and schematizing a textual document. Accordingly I decided to enhance students' achievement in Biology by enhancing such two important skills that requires high intellectual skills and specific scientific language by managing my

class time through an innovative tool that matches such digital age which is flipped learning.

Flipped learning is one of the best active learning strategies that prepares self-learner students enjoying learning on their pace.

In this action research we explored the effect of flipped learning on enhancing grade 11 scientific students' achievement in Biology by enhancing the two mentioned skills.

Quantitative data was collected from pre-tests and post-tests whereas qualitative data was collected from a questionnaire prepared by the researcher.

The results confirmed that flipped learning was a successful tool. After flipping my classroom all of the students mastered the mentioned skills and thus their achievement in Biology was high. In addition students experienced for the first time to be self-learner and problem solver for a certain extinct , thus they enjoyed such experience and asked to learn from time to time through flipped classroom.

This action research recommends the use of flipped learning not only as a time management tool but also as new active learning strategy.

Finally, if all teachers seek professional development through identifying and solving core academic problems in their classes they will lead in development of their schools, and more developing schools will develop education as a whole. And that's what teaching must be a long term teaching learning process!

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Appendices

Appendix A: Revised Version of Bloom's taxonomy

Definitions	I. Remembering	II. Understanding	III. Applying	IV. Analyzing	V. Evaluating	VI. Creating
Bloom's Definition	Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers.	Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions,	Solve problems to new situations by applying acquired knowledge, facts, techniques and rules	Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support	Present and defend opinions by making judgments about information, validity of ideas, or quality of	Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.
Verbs	• Choose • Define • Find • How • Label • List • Match • Name • Omit • Recall • Relate • Select • Show • Spell • Tell • What • When • Where • Which • Who • Why	• Classify • Compare • Contrast • Demonstrate • Explain • Extend • Illustrate • Infer • Interpret • Outline • Relate • Rephrase • Show • Summarize • Translate	• Apply • Build • Choose • Construct • Develop • Experiment with • Identify • Interview • Make use of • Model • Organize • Plan • Select • Solve • Utilize	• Analyze • Assume • Categorize • Classify • Compare • Conclusion • Contrast • Discover • Dissect • Distinguish • Divide • Examine • Function • Inference • Inspect • List • Motive • Relationships • Simplify • Survey • Take part in • Test for • Theme	• Agree • Appraise • Assess • Award • Choose • Compare • Conclude • Criteria • Criticize • Decide • Deduct • Defend • Determine • Disprove • Estimate • Evaluate • Explain • Importance • Influence • Interpret • Judge • Justify • Mark • Measure • Opinion	• Adapt • Build • Change • Choose • Combine • Compile • Compose • **Construct** • Create • Delete • Design • Develop • Discuss • Elaborate • Estimate • **Formulate** • Happen • Imagine • Improve • Invent • Make up • Maximize • Minimize • Modify • Original • Originate • Plan • Predict • Propose • Solution • Solve • Suppose • Test • Theory

Appendix B: Vertical analysis of the competency "Formulate a hypothesis"

Session	Grade 9	Grade 12 ES	Grade 12 LH	Grade 12 LS
2001I	Ques III part b			-
2001II	-	Can't find	Can't find	Ques V part e
2002I	-			Ques I part e Ques III part c
2002II	-			Ques I part a
2003I	-			Ques III part b
2003II	Ques III part d			-
2004I	Ques III part d			-
2004II	-			-
2005I	Ques III part b	-	-	-
2005II	Question 2 part c			-
2006I	-	-	-	-
2006II		Question 3 part d	Question 4 part d	Question 2 part b Preceded by asking a problem
2007I	-	-	-	-
2007II	-		-	Exercise 1 part 1
2008I	-	-	Exercise 2 part 1	-

			Formulate 2 hypothesis	
2008II	-	-	Exercise 1 part 1	-
2009I	-	-	-	-
2009II	-	-	-	Exercise 3 part 4
2010I	-			Exercise 2 part 3
2010II				-
2011I	-	-	-	-
2011II	-	-	-	-
2012I				
2012II	-	-	-	-
2013I	-	-	-	-
2013 II	-			-
2014				Exercise 3 part 3 Exercise 4 part 3
2015I	-		-	Exercise 1 part 4
2015II	-	-	-	-
2016I	Not searched			Exercise 1 part 2(Formulate 2 hypothesis) Exercise 3 part 3 Exercise 4 part 6
2016II		Exercise 2 part 3		-

Appendix C: tabulated links that included the e-lessons used for flipped learning

Links used	Details
www.mix.office.com/watch/1hb2wqkc1na2r	Office mix link for pilot flipping
www.mix.office.com/watch/10jvxqyo7neow	Office mix link for lesson 1:Transcription
www.mix.office.com/watch/1bz1snulog3ed	Office mix link for lesson 2 Part 1:Tools of translation
www.mix.office.com/watch/1hk4dd4sr	Office mix link for lesson 2 part 2:Stages of translation
www.youtube.com/watch?v=ztPkv7wc3yU	Link for video of transcription
https://www.youtube.com/watch?v=5bLEDd-PSTQ	Link for charging of tRNA
https://www.youtube.com/watch?v=5bLEDd-PSTQ	Link for stages of translation

Chapter 4: Protein synthesis & enzymatic activity   Grade 11/S

Learning Objectives	By the end of this session ,students will be able to: -Define gene expression, transcription& translation. -Indicate the cellular level of transcription & translation
Prerequisites	Notion of gene,amino acids,DNA
Materials	Textbook Figure of Rosetta stone https://www.google.com.lb/search?q=Rosetta+stone&source Board Activity sheets 1,2,3

Lesson Development (5E model)

Engage

Start the class off by asking students what they know about proteins based on their previous knowledge of cells, DNA and the human body.

➢ Think-Pair-Share: Ask students to take about 30 seconds to come up with ideas, and then take another minute to discuss these ideas with their neighbor.

Explore

Illustrate how transcription and translation work through an example.

 Introduce these concepts by showing students figure of the Rosetta stone

☐ The Rosetta Stone is a very important part of Egyptian history.

☐ It is a large black granite stone bearing three inscriptions: (1) ancient Egyptian hieroglyphs, (2) Egyptian demonic script and (3) Ancient Greek.

It is considered the "key to modern understanding of Egyptian hieroglyphs" since it contained the same passage in these three different languages.

 Issued at Memphis, Egypt in 196BC on behalf of King Ptolemy V. It is believed to have been created following the coronation of King Ptolemy V, and the decree established the divine cult of the king.

 It is believed to be housed at various locations, but is now located at the British Museum (1802) where it is on display to the public.

 But what does this have to do with transcription and translation?!

1. We want to know what the script says. We cannot take the stone away from the British museum because it is too big (over 1,000lb!) and because it is against the law! So how do we go about trying to figure out what is written on the stone?

2. First, we must go to the British Museum and "Transcribe", or copy, the text onto a piece of paper that we can carry with us.

3. However, we cannot read any of these ancient texts! So what do we do next?

4. We must take the paper containing the **transcribed** text and bring it to **translators** outside of the museum who are able to read the language and **translate** it to English.

ii. The process of turning DNA into protein is very similar to this. DNA is found within the nucleus of a cell. It must stay within the nucleus, so we must go there to **transcribe** it. The **transcribed** material (mRNA) is then able to leave the nucleus and be **translated** into amino acids which make up a protein. Let's see if we can understand the process through doing this activity.

iii. Knowing that information, you can go back and ask the questions:

1. What does the museum represent? **Nucleus**

2. What does the individual transcribing the text represent? **Transcription**

3. What does the translator represent? **Translation**

Explain

Using flipped learning explain transcription and translation

Elaborate

Solve application exercises from activity sheets 1,2 &3.

Evaluate

Formative assessment (Questioning/Discussion)

Summative Assessment (Quiz)

Appendix E: Experimental protocol of self-inflating balloon experiment

The experiment was done also in the lab, where I conducted the experiment that proves that respiration of living things lead to the inflating of the balloon. I used three empty plastic water bottles the first one was a control containing yeast sugar and water and I placed a balloon on the top of the balloon. The second one was missing sugar and the third one was missing water but on both of them I placed on the top a balloon by this I taught them when conducting an experiment they must vary only one factor(so as to have one variable factor),

Self-inflating balloon: Combine Biology and Physics to blow up a balloon with the power of yeast! You will need:

1. A used washed fizzy drinks bottle (lid not required)
2. Latex balloon (thinner the better)
3. Elastic band
4. Measuring Jug
5. Yeast
6. Sugar
7. Water

What to Do: Place 2 teaspoons of yeast, 1 teaspoon of sugar and one cup of water into the bottle. Put the balloon over the top of the bottle and secure with the elastic band. Leave, but keep an eye on it

What's happening? Yeast is actually a micro-organism. The yeast is 'eating' the sugar and respiring. A product of respiration is Carbon Dioxide, which slowly fills up the balloon.

Appendix F: Course used for explanation

*Brief explanation of flipped learning:

- **Definition of flipped classroom**:

The **flipped classroom** is a educational **model** in which the typical lecture and homework elements of a course are reversed. Short video lectures are viewed by students at home before the **class** session, while in-**class** time is devoted to exercises, projects, or discussions.

- Role of teachers

-Prepare well organized course that facilitate the students' learning when they are at home.

-Guiding discussion in the classroom in such a way students will gain all information they misunderstood at home.

-Allow students to apply and test their knowledge by solving well prepared application exercises for the lessons learned.

- Role of students

-Act as self-learner at home and try to understand as much as they can at home to come into the class with needed academic background (or knowledge)

*Brief explanation of scientific method (including hypothesis):

1.Ask a question

- ✓ Good questions derive the scientific method which come from careful **observations.** You make observations by using your senses to gather information. Sometimes you may use instruments, such as microscopes and telescopes, to extend the range of your senses.
- ✓ Questions beginning with *what, why, how,* and *when* are very important in focusing an investigation, and they often lead to a hypothesis.

Example: How does acid rain affect plant growth?

2.Form a hypothesis

- ✓ After you come up with a question, you need to turn the question into a **hypothesis.**
- ✓ A hypothesis is a clear statement of what you expect the answer to your question to be. Your hypothesis will represent your best "educated guess" based on your observations and what you already know.

Example: Hypothesis: Acid rain causes plants to grow more slowly.

NOTE

DON'T MIX UP between A PREDICTION & A HYPOTHESIS

A prediction is what you think will be the outcome of your experiment or data collection. Predictions are usually stated in an "if . . . then" format

Prediction: If a plant is watered with only acid rain (which has a pH of 4), then the plant will grow at half its normal rate

3. Test the Hypothesis by planning an experiment

- ✓ There are different ways to do this. Perhaps the most familiar way is to conduct a **controlled experiment.**
- ✓ A controlled experiment tests only one factor at a time. A controlled experiment has a **control group** and one or more **experimental groups.**
- ✓ *All the factors for the control and experimental groups are the same except for one factor, which is called the variable. By changing only one factor, you can see the results of just that one change*

4. Analyze the Results

- ✓ After you have completed your experiments, made your observations, and collected your data, you must analyze all the information you have gathered. Tables and graphs are often used in this step to organize the data.

5. Draw Conclusions and communicate results

- ✓ Based on the analysis of your data, you should conclude whether or not your results support your hypothesis.

If your hypothesis is supported, you (or others) might want to repeat the observations or experiments to verify your results.
If your hypothesis is not supported by the data, you may have to check your procedure for errors. You may even have to reject your hypothesis and make a new one. **If you cannot draw a conclusion from your results, you may have to try the investigation again or carry out further observations or experiments.**

- **Definition of a hypothesis:**

The word hypothesis is made up of 2 Greek roots which roughly means some sorts of "sub statements".

The word hypothesis consists of two words Hypo+ thesis where "Hypo" means **tentative** or subject to the verification, and "thesis" means statement about solution of problem

Another meaning "Hypo" means a composition of two or more variables which is to be verified and "thesis" position of these variables in the specific frame of reference

Main Characteristics of a good hypothesis:

- ✓ Capable of Verification
- ✓ Related to the Existing Body of Knowledge
- ✓ Be Precise, Simple and Specific
- ✓ In the form of tentative generalization which requires a knowledge of principles of things or essential characteristics which pertain to entire case of phenomena
- ✓ Testable proposition

*Brief overview on the digestive system:

All organs, tissue, and cells of the human body need nutrients to live and grow. Providing nutrients to the body is the function of the digestive system. The digestive system is a series of tubes and organs connecting from the mouth at one end, to the anus at the other end.

The function of the digestive system can be broken down into six major actions:

- Move food and liquids along the digestive tract
- Lubricate the food to ease movement along the digestive tract
- Mechanically breakdown carbohydrates, fats, and proteins
- Chemically breakdown carbohydrates, fats, and proteins(organic food/complex food)
- Reabsorb nutrients and water
- Eliminate waste products

Finally nutrients will travel from the small intestine into the blood which are then oxidized in order to releases energy (oxidation) that is needed for our cellular activities.

*Brief explanation of the nervous system:

The nervous system is composed of the central nervous system (brain & spinal cord) and the peripheral nervous system (nerves).Thus the functional unit of the nervous system is the neuron.

The neuron is made up of three main parts : Cell body, Axon & terminal arborization.1/3 of the neurons are myelinated but 2/3 of them are not.

Myelin is a white lipid structure produced by schwan cell that is responsible for speeding up the nervous message.But myelin is not the only factor that speed the nervous message .but the diameter of the nerve fiber(as diameter increase the speed increase) and the temperature (as temperature increase the speed increase).

How is the nervous message (electrochemical energy:action potential) transmitted from one neuron to another?

Through synapse: it is a gap junction between a nerve cell(presynaptic element) and an effector cell:post synaptic element (neuron,muscle or cell of gland) that allows the transmission of the nervous message through chemical called neutransmitters.

Thus we may have: Neuroneuronic synapse, neuromuscular synapse or neuroglandular sysnapse.

*Steps of synaptic transmission:

Consider a neuroneuronic synspse:Steps of synaptic transmission along such synapse:

1.Arrival of action potential along the presynaptic neuron causes the opening of the calcium channel.

2.The entrance of calcium ions inside the presynaptic neuron stimulate push the vesicles containing neurotransmitters to empty their content by exocytosis into the synaptic cleft.

3.The released neurotransmitters will bind on their postsynaptic receptors and change the postsynaptic potential.

4.A hydrolytic enzyme that is produced by the synaptic cleft will break down the bound and unbound neurotransmitters that are/or recaptured by the presynaptic neuron

Appendix G: sheets for practice

Handout #1 : Practicing on Schematizing

I.Definition of Schematize:

Arrange or represent in a schematic form

II.Checklist to schematize a TEXTUAL document

Plan

1. Read the whole document carefully.
2. Underline each step and match the legends given for each step.
3. Identify the chronological order of the steps.
4. Circle the verbs used in each step
5. Circle the tools used in each step.

Do

6. Identify, in the document, the words and verbs to be used for the legends and write them on your answer sheet with their drawings as a legend key.
7. Choose other legends for unidentified tools and add them to the legend key.
8. Illustrate the steps using all of the legends paying attention to the order of the steps.
9. Write a title for your schema.

Review

10. Describe your schema into a text (without looking at the original given text in the document)
11. Compare the text you wrote with the original text given to (add any missing information or delete any extra information).

III.Practice on schematizing

Question 1

Based on Documents 1 & 2, schematize the steps of producing transgenic corn plant.

In order to manufacture transgenic corn plants, a soil bacterium, *Bacillus thuringiensis* (Bt) that naturally produces an insecticide protein has been used. The gene coding for this protein has been isolated from the plasmid of this bacterium and introduced using DNA ligase into the nucleus of the corn cells. Finally culture these cells to obtain transgenic corn plant.

Document 1
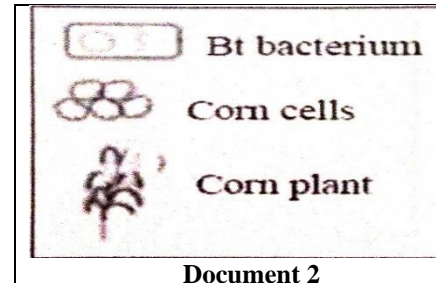
Document 2

Question 2

Based on Documents 1 schematize the steps of producing peptide vaccine.

We extract the viral protein gene from the DNA of the hepatitis B virus that has viral proteins on its surface. We isolate the plasmid of a bacterium called Colibacillus and we integrate the viral protein gene into the bacterial plasmid. This recombinant plasmid is then transferred into a yeast cell. The viral gene is integrated into the DNA found in the nucleus of the yeast cell that will secrete the viral protein. Then, the vaccine is produced.
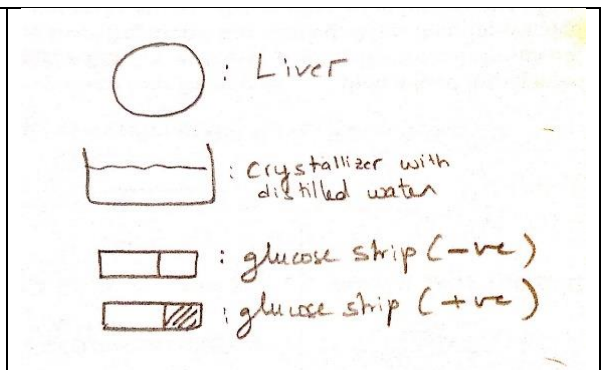
Document 1

Question 3

Based on Document 2 schematize the steps shown in Document 1.

The fresh liver is cut into fragments, and then added into a crystallizer containing distilled water. After that a strip to detect glucose is introduced, the test is positive.
After that the liver fragments are washed. After that the washed fragments are put in in a crystallizer and a strip to detect glucose is introduced, the test is negative. After incubation during 20 minutes at 37°C, a strip to detect glucose is introduced, the test is positive.

Document 1

Document 2

Handout # 2 for the action verb "Formulate a hypothesis"

I. Definition of a hypothesis:

The word hypothesis is made up of 2 Greek roots which roughly means some sorts of "sub statements".

The word hypothesis consists of two words Hypo+ thesis where "Hypo" means **tentative** or subject to the verification, and "thesis" means statement about solution of problem

Another meaning "Hypo" means a composition of two or more variables which is to be verified and "thesis" position of these variables in the specific frame of reference.

II.Types of hypothesis:

Type 1: formulate a hypothesis that is tested in such experiment →doesn't require prior knowledge.

Type 2: formulate a hypothesis that may explain the results obtained→ requires prior knowledge.

Examples:

Type 1:

In the framework of research on the relation between cigarette smokers and lung cancer, studies are conducted in a medical center, on patients suspected of being infected with lung cancer.
The results are presented in the table below.

	Non-smokers	Smokers			
Quantity of tobacco consumed	0	1-4	5-14	15-24	>25
Percentage of patients with lung cancer	31	36	48	53	73

➤ Formulate the hypothesis tested by this research study.

III.Checklist for solving Hypothesis:(can be applied for both types)

1.Pose the convenient problem based on your observation to the situation.

2.Pick out the prior knowledge*

3.Find possible relations between variables if present*

4.Write a simple, specific, tentative declarative statement preceded by the word hypothesis, that is capable of verification.(testable proposition)

In this handout we will practice on solving   formulating a hypothesis based on prior knowledge(type 2)

Question 1

Fadi and Ziad meet at a restaurant for lunch. Each one of them chooses a menu as presented in document 1.

Name	Menu
Fadi	Fish + carrots + grapes
Ziad	Chicken + Salad + apple

Document 1

Four hours after lunch, we remove a sample of the contents of the small intestine of Fadi and another sample from the intestine of Ziad.

Document 2 reveals some of the nutrients of these contents.

Nutrients of the contents of the small intestine of each of Fadi and Ziad
Glucose, Amino acids, Fatty acids, glycerol

Document 2

After this meal, the analysis of blood that leaves the small intestine of each of Fadi and Ziad shows an increase in the quantity of glucose, amino acids…

➢ Formulate a hypothesis that may explain this increase.

Question 2

We measure the concentration of glucose, amino acids and oxygen in the blood as it enters
and leaves the small intestine. At the same time, we observe a change
in the color of the blood. The results are represented in the document
below.

	Blood entering the small intestine	Blood leaving the small intestine
Glucose	1 g /L	1.3 g/L
Amino acid	0.2 g/L	0.5 g/L
Oxygen	200 mL/L	160 mL/L
Blood color	Bright red	Dark red

➢ Formulate a hypothesis that explains the loss of oxygen in the
blood at the level of the small intestine.

Question 3

Document 2 reveals the relation between the diameter and the speed of conduction of the nervous message in two different nerve fibers: one from the squid and the other from a cat.(knowing that both fibers were placed at the same temperature)

Nerve fiber	Diameter (in μm)	Speed of conduction
Squid	650	24
Cat	4	26

➢ Formulate a hypothesis that explains the obtained results.

Question 4

Experiment 2: Botox is added to the culture medium of the experimental set up of experiment 1. The same stimulations as well as the same measurements are repeated. Same results as those of experiment 1 are obtained except for the quantity of the released acetylcholine. In addition, no muscular contraction is observed for the 4 intensities of stimulation.

| Intensity of	Quantity of released
5	30
10	40
15	50
20	60

➢ Formulate a hypothesis explaining the mode of action of Botox on the transmission of the nervous message.

Activity sheet 1   **Lesson 1: Transcription**

In transcription, RNA polymerase splits the two halves of a strand of DNA.RNA then uses one half as a template to make a copy of the other half. RNA contains the nucleotide uracil instead of the nucleotide thymine.

1.Label the DNA and RNA shown in the figure below. Then, label the missing nucleotides marked on the diagram.
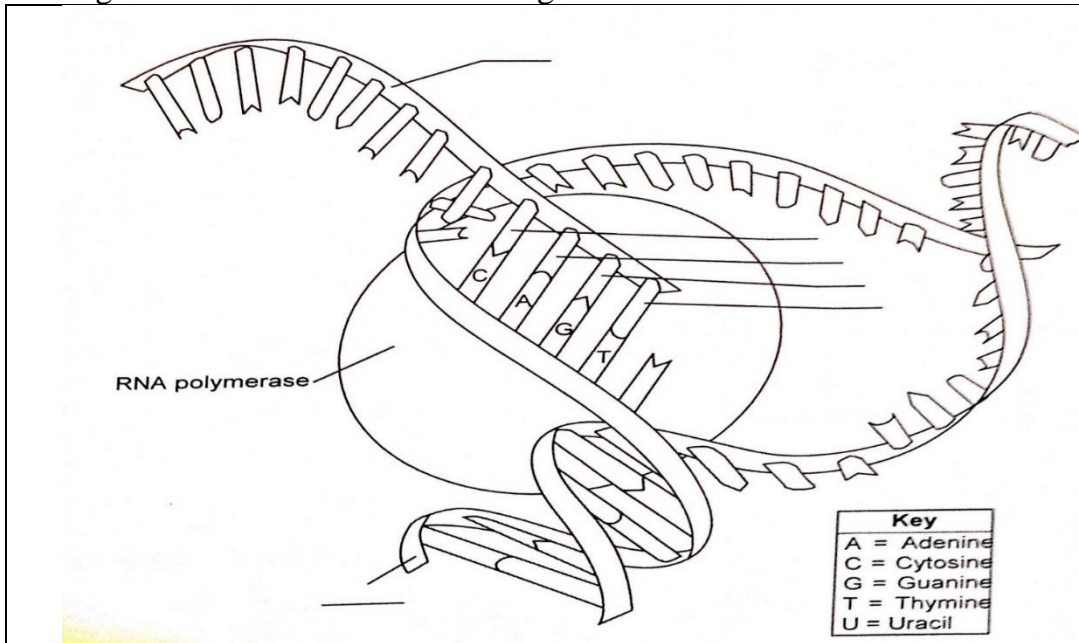
2.In RNA ,which nucleotide is always paired with uracil?

  Answer the following questions briefly:

I.DNA v/s RNA

How are DNA and mRNA alike

2.How are DNA and mRNA different?Fill in the table below:

DNA		mRNA
	Shape	
	Nitrogen bases	
	Sugars	
	Location	

II. Transcription: DNA to mRNA:

1. How many strands of mRNA are transcribed from the two "unzipped" strands of DNA?

2. If the following were part of a DNA chain, what mRNA bases would pair with it to transcribe the

DNA code onto mRNA? G-G-A-T-C-G-C-C-T-T-A-G-A-A-T-C

3. If DNA is described as a double helix, how should mRNA be described?

4. How are the accuracy of DNA and mRNA codes assured?

III. Comparing DNA Replication and Transcription

DNA replication is the process by which a cell copies its DNA. During replication, both strands of the double helix are used as templates to make complementary, or matching, strands of DNA. DNA transcription is the process by which a single strand of DNA is used as a template to generate a strand of mRNA.

➢ *Fill in the missing information. One row has been completed for you.*

| Template DNA	Complementary DNA	Messenger RNA (mRNA)
TTACG	AATGC	AAUGC
	GGCGG	
		ACGUAGC
AGACTC		
	GATAAGA	
		CUGGCUAC

Use the table to answer the question.

1. Give another example of a template DNA code that is at least four base pairs long. Then give its matching complementary DNA and mRNA codes.

_____

_____

Activity sheet 2   **Lesson 2 :Translation (part 1)**

I.Decoding mRNA

The diagram shows the mRNA codes that correspond to amino acids and stop codons. Read the diagram from the center outwards. For example, the mRNA code UAC corresponds to the amino acid tyrosine.

1. Write the name of the amino acid that corresponds to each RNA code shown in table below.The first one has been done for you.

mRNA Code	Amino Acid
AAA	lysine
GCG	
GAU	
CAA	
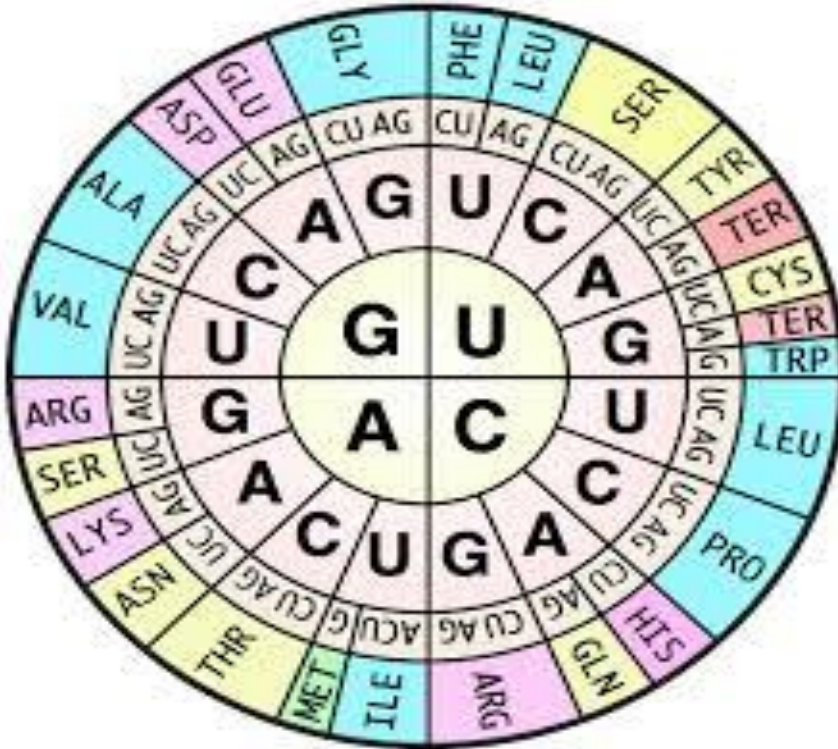
2.Use the diagram to answer the questions.
   a. Which two mRNA codes correspond to histidine?
   _____

   b. How many different mRNA codes correspond to arginine?
   _____

II. 3 kinds of RNA

1.-------------- -**messenger RNA**
       Structure: ----------------
       Function: carries the -------------- message from the nucleus to the ribosomes.

2.------------- -**transfer RNA**

      Structure: has an ----------------- that is a complement to the ------------ at one end and a ---------------- at the other end.

      Function: carries the ---------------- to the ribosomes for protein production.

3.------------- -**ribosomal RNA**

      Structure: A part of ribosome

      Function: creates the ----------------- between the amino acids during protein production

III.Transfer RNA

During translation, transfer RNA (tRNA) anticodons match to messenger RNA (mRNA) codons. Each tRNA molecule can carry one particular amino acid. The amino acids are joined to form
a polypeptide.

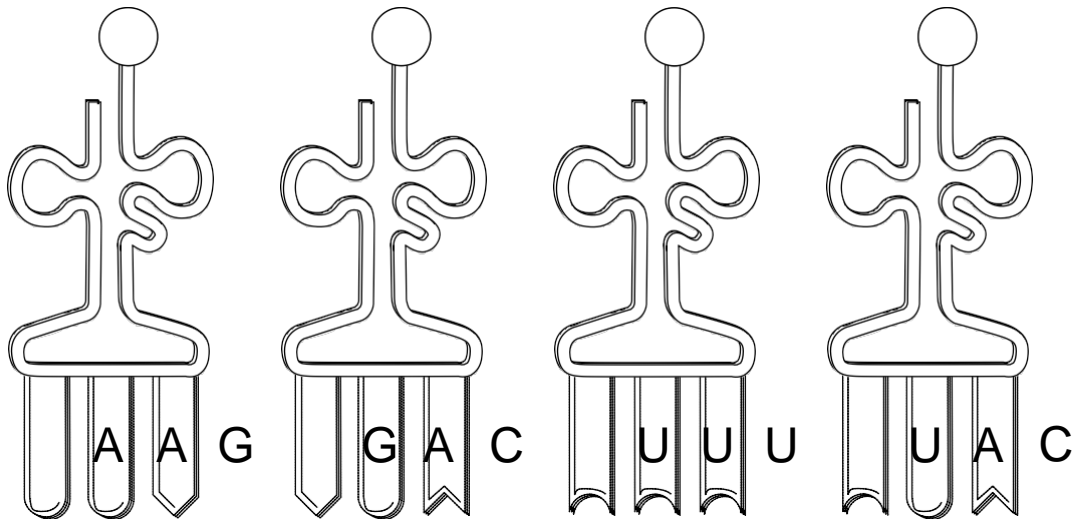***1. Number the four tRNA anticodons in the order in which they should appear to match the codons in the mRNA strand.***
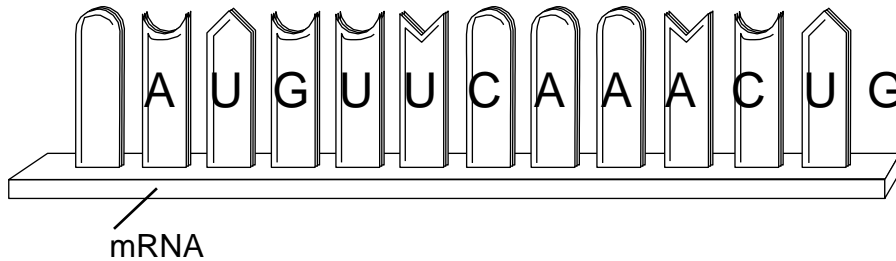
mRNA

phenylalanine   leucine   lysine   methionine

A A G   G A C   U U U   U A C

----- ***2.Use the diagrams to answer the question below:*** -----

  List the amino acids in the order they would appear in the

  polypeptide coded for by the mRNA.

_____

_____

IV.Translation: mRNA to PROTEIN:

Answer the following questions briefly:

1. Where must an mRNA attach before protein production can begin?

2. If a strand of mRNA contain the sequence, U-A-G-C-U-A-U-C-A-A-A-U, what tRNA anticodons would be needed to translate the sequence?
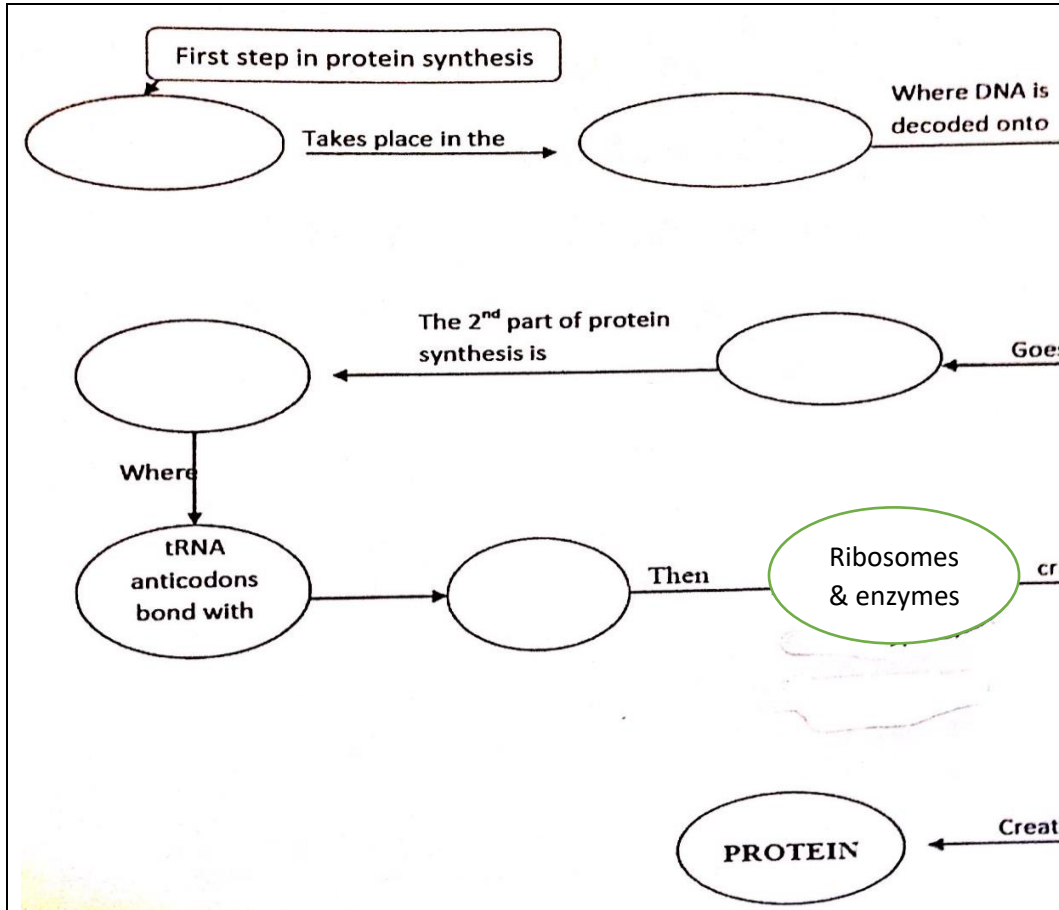

3. How does mRNA get out of the nucleus?

4. What is the difference between an amino acid and a protein?

5. What type of bond is formed between amino acids?

Activity sheet 3   **Lesson 2: Translation (part 2)**
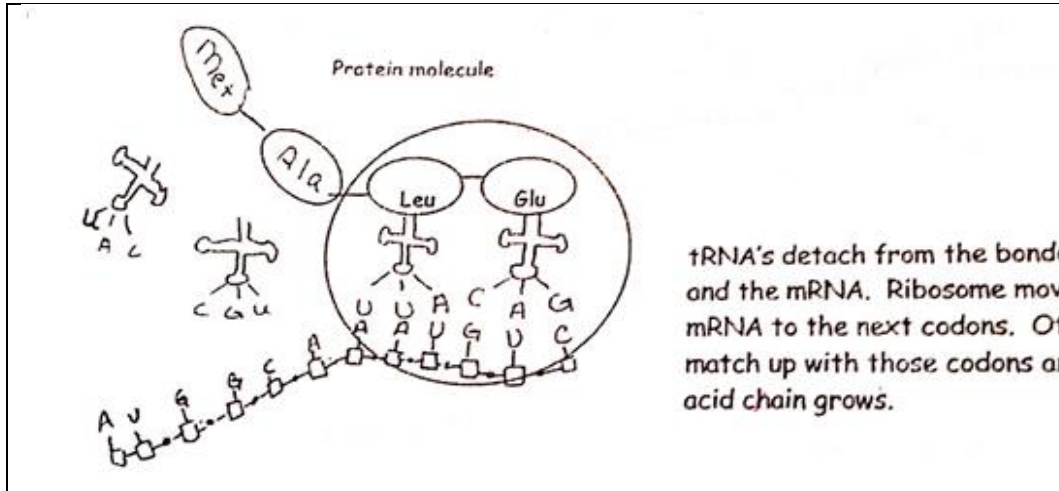
I.Protein Synthesis Flow Chart

Directions: Fill in the flow chart below, using the following words:
Amino acids, mRNA, mRNA codon, nucleus, nuclear pore, peptide bonds, ribosome, and transcription.

First step in protein synthesis

Takes place in the →

Where DNA is decoded onto

The 2nd part of protein synthesis is ←

Goe

Where

tRNA anticodons bond with →

Then

Ribosomes & enzymes

cr

Creat

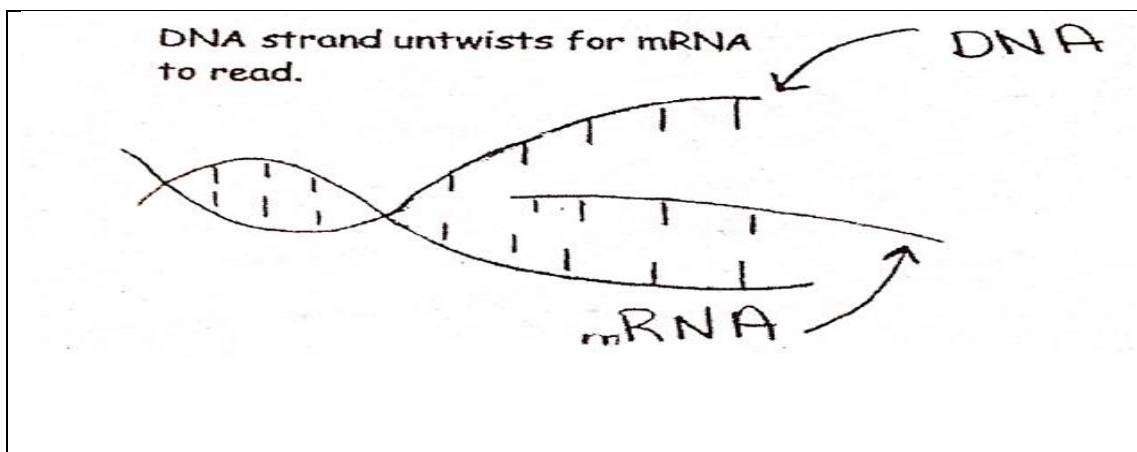PROTEIN ←

II. Stages of Translation

Directions: Number the following pictures (1-6) along the left hand side in the correct order of how protein synthesis takes place. Then answer the bolded question in each of the 6 sections

#-----

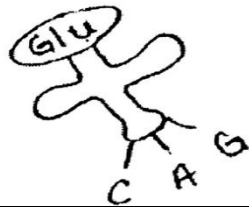tRNA's detach from the bond and the mRNA. Ribosome mov mRNA to the next codons. O match up with those codons a acid chain grows.

What is the amino acid chain called?

#-----

DNA strand untwists for mRNA to read.

DNA

mRNA

Where is the DNA found?

#------

tRNA's in the cytoplasm carry amino acids to the ribosome.

What is tRNA?

#-----

mRNA moves from the nucleus to the ribosome.
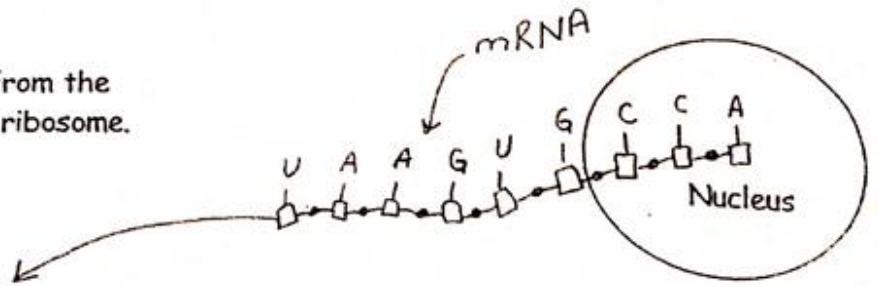
What is mRNA?

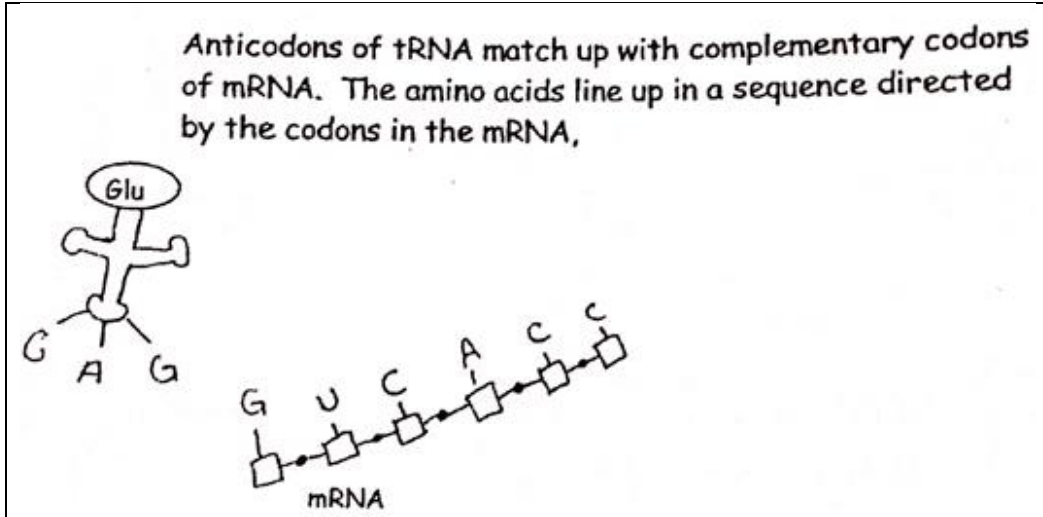
#-----

Covalent bonds form between the amino acids.
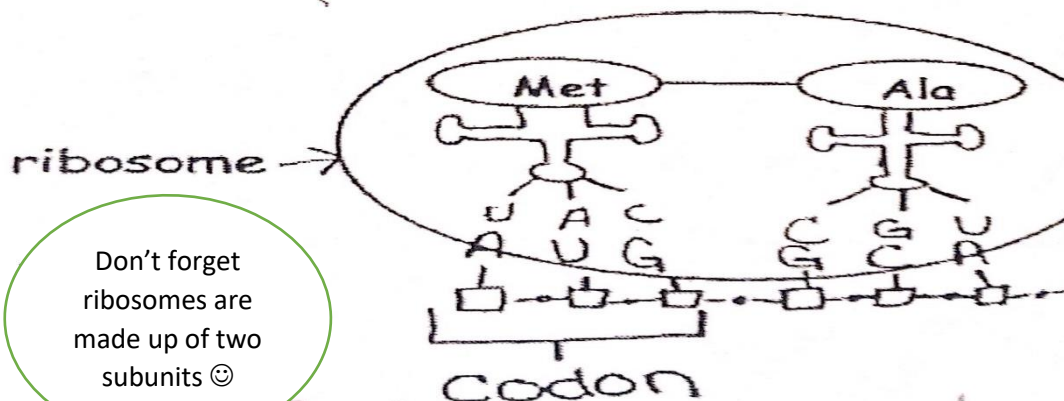
Don't forget ribosomes are made up of two subunits ☺

What are the covalent bonds between the amino acids called?

#-----

Anticodons of tRNA match up with complementary codons of mRNA. The amino acids line up in a sequence directed by the codons in the mRNA,

What is a codon?

Easter Vacation sheet

Student's Name:-------------------   Corrected by:----------------
Grade:

Biology Activity sheet
For Easter vacation
From Ms Heba Salam
To my lovely students in
Grade 11/S

Answer the following questions briefly

1.How many different kinds of bases can be found on DNA _____

2. What base is found on RNA but not on DNA? _____

3. How many bases are in a codon? _____ In an anticodon? _____

4. How many amino acids are attached to a single transfer RNA? _____

5. Transcription occurs in the _____; translation occurs in the _____.

6. The process of making RNA from DNA is called _____ and it occurs in the

_____

7. The process of assembling a protein from RNA is called _____ and it occurs in the _____

8. When messenger RNA (mRNA) is being made the RNA base_____ always pairs with which DNA base_____

9. Which organelle is involved in translation?_____

10. What is the product of transcription?_____

11. To what part of the cell do the products of transcription travel?_____

12. Consider the following DNA strand: Write the sequence of bases for the product of transcription here: Remember! transcription produces RNA using the DNA strand as a template!

TAC CGT TCT GCT AAA TAT ACC ACT

13. What is the third **codon** in the mRNA you produced in?

14. What is the function of the following in translation?

Messenger RNA

Ribosomal RNA

Transfer RNA

Appendix H: Students' feedbacks

From Pilot flipped learning feedbacks

- ✓ *Some words were hidden by the video while I was talking and under the figures.*
- ✓ *There was noise from background which made the voice low, they suggested to use a microphone.*
- ✓ *Handwriting is not that clear when using the touch pen*
- ✓ *Sometimes you talk fast*
- ✓ *We prefer if you use more colors and make words bigger*
- ✓ *It was time consuming while downloading the video*

In addition, 12/22 students didn't understand the 5'-3'/3'-5' antiparallel idea of DNA --- and most students copied the information from the slide

Mistakes of my students after making first time schematize:

2/27 students missed using legends, for example, the plasmid wasn't given a legend.

1/27 students used non logical legends, for example using a square to illustrate an insulin gene.

8/27 students forgot to put a title.

2/27 students missed steps and didn't know how to relate ideas.

3/27 students didn't do description

6/27 students were able to apply the seven steps for the checklist and did a correct schematize

Students feedbacks from lesson 1

10/27 students didn't understand the hairpin loop idea mentioned in the Termination stage

7/27 students didn't understand the idea that mRNA is unstable molecule.

1/27 student mentioned that he didn't understand the tools of translation

Notes while solving activity sheet # 1 (from 2 sessions):

Concerning question 1 in the first set of questions: all of the students wrote only two common ideas between the DNA and the mRNA which are the location and the nitrogenous bases but they missed the following:

- ✓ *DNA and RNA are made up of monomers called nucleotides.*

✓ *DNA and RNA both contain pentose sugars.*

✓ *DNA and RNA both have 3 nitrogenous bases: Adenine, Cytosine and Guanine.*

✓ *DNA and RNA both have a phosphate groups in their nucleotides. Sometimes called phosphoric acid.*

✓ *They both have the base pair of Guanine and Cytosine.*

✓ *They are both necessary for the cell to produce proteins.*

✓ *DNA makes mRNA which then is translated into protein.*

Concerning question 4 in the second set of questions which is as follows:" How are the accuracy of DNA and mRNA codes assured?":

1. Complementary base pairing using the fixed base pairing rules (C-G, A-T, G-C, T-A),
2. The DNA polymerase "proofreading" function which detects when a mismatch has been made during replication, chops the offending base off the newly forming strand, forces the DNA polymerase to back up one position, and do a do-over. Different answers were:by:

✓ *RNA polymerase*
✓ *fixed based pairing*
✓ *genetic codes table*
✓ *uracil*

One student answered by specific way

And the rest didn't solve it

Some Students' feedback from lesson 2 part 1

A misunderstood idea was the type of bond between the amino acids in the growing chain, where some students called it polypeptide bond instead of peptide bond.

 Some students referred to the ribosomal subunits as rooms or pieces which is unaccepted since I clarified in the video that they are referred as subunits.

In addition five students didn't understand the idea of charging of tRNA. One student asked if I can include an animated video.

All my students' feedback this time were positive and among them is "the video was really better than the previous one and what is more important is the figures

which made the information easy to be understood and increased my understanding to subjects".

Some Notes while solving activity sheet #2:

- Some students were confused using the codon wheel instead of the genetic code table (since it wasn't mentioned in the animated power point) but I insisted to let them apply the same principle of the genetic code table through mRNA codon wheel.
- Most of the students filled that the function of ribosomal RNA (rRNA) is to create ribosomes.Accordingly I clarified that rRNA since it is involved in the synthesis of ribosomes but as it was mentioned in the question they were supposed to say that it creates peptide bond between the amino acids.

Concerning question 4 of part IV different answers were collected:

- ✓ *amino acid is smaller than proteins*
- ✓ *amino acid is nonfunctional but the protein is functional*
- ✓ *proteins are made up of amino acids*

Students' feedback from lesson 2 part 2

Some students named the initiation codon as promoter and named the stop codon as terminator. So they didn't distinguish between transcription and translation correctly concerning this idea. But other students grasp the information correctly and were able to list such information as comparison and not misconception

5/27 students filled wrong outcome (not functional protein always) wasn't able to draw the whole initiation complex write a definition for translation

A misconception in drawing the P site and the A site although they explained initiation of translation correctly.

Others included the term chemical reaction when was describing elongation/tRNA is not inside /stop codon enters the ribosome and makes a series of events -/filled wrap up correctly/didn't make order for steps/he understood the question wrong answered ques 3* /4,5 wrong

Misconception small subunit of ribosome attaches on mRNA first (missing without tRNA)

4/27 had the misconception about the outcome of translation where they wrote that it is functional protein and that is wrong because the protein that is produced can be structural, and not always functional.

*Pretest

Pretest /20	Time:60'	Date:
Friday March 17th 2017		

Answer the following exercises

Exercise 1(6pts)   The Regulatory System of Glycemia

In the frame work of studying the regulation of glycemia, experimental data have been collected from healthy people or animals. Document 1 shows the glucose concentration in the blood entering and that leaving the muscle and the encephalon.

	Glucose concentration (in mg/100 mL of blood)	
	Blood entering	Blood leaving
Muscle at rest	90	87
Encephalon at rest	91	80

Document 1

1. Analyze document 1 and draw out the adequate
relation.**(Domain B-1pt.)**

2.Represent in two different histograms the glucose concentration in blood entering the muscle and the encephalon as well as the blood leaving.

(Domain D-2pts.)

Document 2 represents the variations in the concentration of insulin and glucagon secreted by the
isolated pancreas of a dog that is perfused with a liquid having different glucose concentrations.

3. Interpret the results of document 2.

   (Domain B-1pt)

We measured the amount of glucose consumed by encephalon cells in a medium with or without insulin. The result showed

Document 2

that this consumption was around 6g/h in both media with and without insulin.

4.Knowing that insulin is normal, Formulate a hypothesis that may explain the result obtained.**(Domain B-2pts.)**
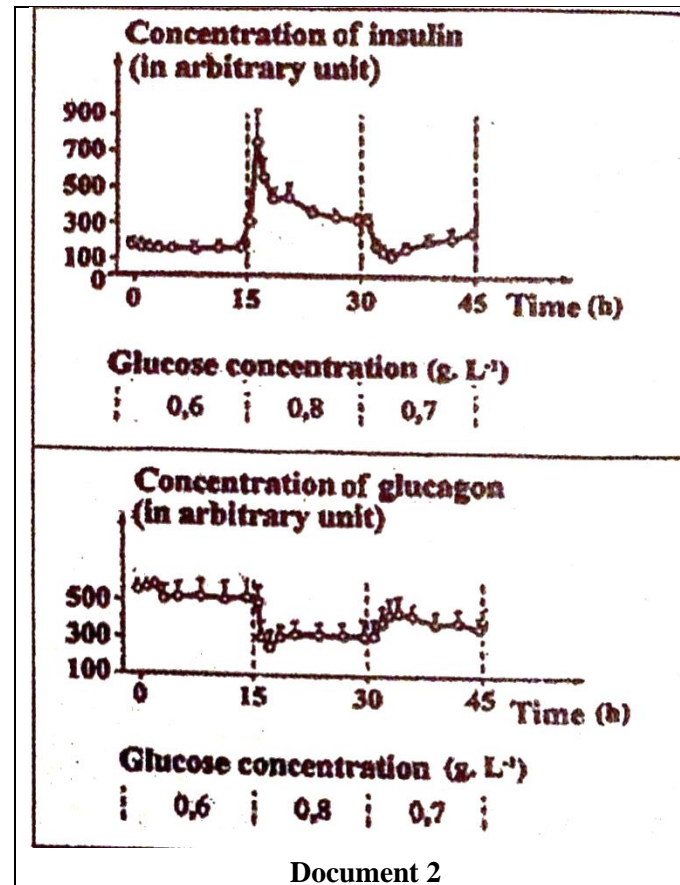
Exercise 2 (6pts)   **Ribonuclease**

Ribonuclease is an enzyme of the pancreatic juice that is also present in the nucleus and the cytoplasm of the cells. It carries out degradation of ribonucleic acid (RNA).This enzyme is a protein that consists of a long chain of amino acids which, when functional, possesses disulfide bridges between the amino acids cysteine at four sites.

Among the studies realized by biochemists concerning this ribonuclease molecule is treating the enzyme with SDS (sodium deodecyl sulfate).SDS is the most common denaturing agent used to denature proteins to become rod like structure and consequently inactive, instead of having a complex tertiary structure.

1. Pick out from the text: **(Domain B-1pt.)**
   1.1 The denaturing agent used.
   1.2 The functional and the non-functional forms of ribonuclease.

2. Based on the information given by the text, justify the cause of the usually short life span of RNA.
   (Domain B-1pt.)

Document 1 represents the different aspects of ribonuclease enzyme in the normal functional form (A) and upon treating it with SDS, form (B).

Form A   **Document 1**   Form B
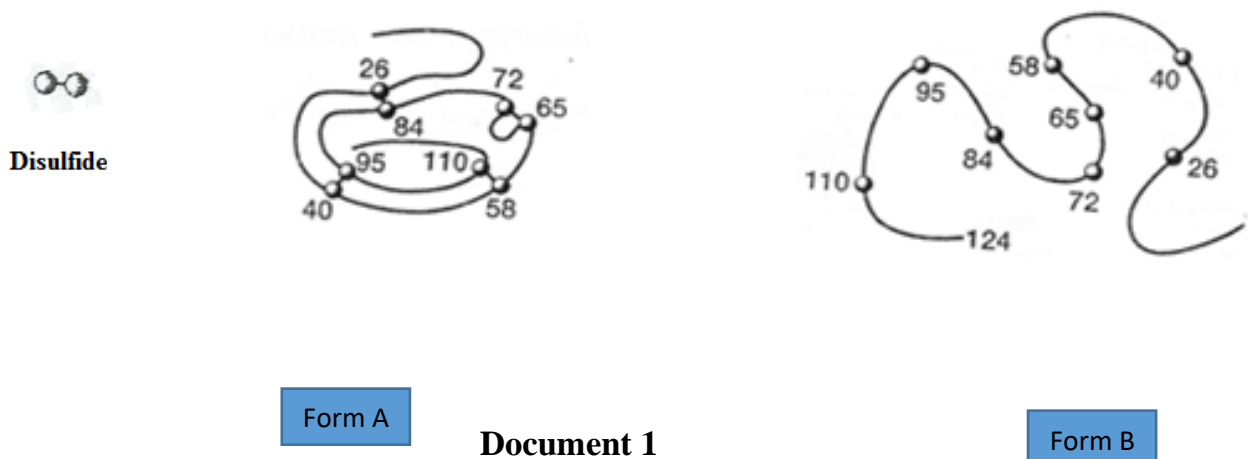
3.1 Compare the structure of the two different forms of protein. **(Domain B-1pt.)**
3.2what can you conclude?**(Domain B-0.5pts.)**

Document 2 shows the chromatogram of some amino acids as well as the chromatogram of normal functional protein.

Solvent 1

	Asp					met
		Glu				
Cys	Ser				Phe	
		Gly				
	Thr				Glu	Gln
		Ala				
			Tyr			
His				Val		

The chromatogram of some amino acids

Solvent 1

	Asp					met
		Glu				
Cys					Phe	
	Thr					
			Tyr			
				Val		

The chromatogram of the normal functional protein

Solvent 2 (vertical label on left of both tables)

Document 2

4. Based on your acquired knowledge, and into consideration the results of Document 2, draw the chromatogram of the inactive protein (Form B).
   (Domain A-1pt.)

5. Calculate the number of nucleotides in the gene coding for this protein.**(Domain A-1.5pts.)**

Exercise 3 (8pts)   **Production of growth hormone**

Growth hormone is a human molecule necessary for growth.

We seek to obtain large quantities of this molecule by synthesizing it using bacteria (Escherichia coli). The steps of this biotechnology method are listed in Document 1.

1.Schematize the steps of such technique using, the information of listed in document 1.
(Domain D-3pts.)

2. Name the biotechnological method used in this technique,then define it.**(Domain A-1.5pts.)**

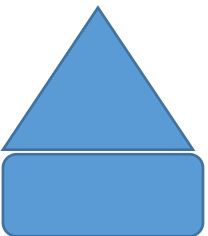3. Pick out from the document the donor and the recipient of the transferred gene.
(Domain B-1pt.)

Using a restriction enzyme we isolate the growth hormone gene from a nucleated human cell.On the other hand we isolated from Escherichia coli (E.coli) bacterium a plasmid.(which is a circular DNA).After that we cut such plasmid using the same restriction enzyme and we remove the fragment that was cut,and we replace it with the gene of interest using DNA ligase.Thus we obtained a recombinant plasmid that was transferred into the bacteria.Finally bacteria multiplied and produced growth hormone.

Legends: Human cell

Bacteria:

Document 1

4- Explain why the insulin protein produced is of of human nature although it was purified **(Domain A-2pts)**

5. Draw out the medical application of this biotechnological method.**(Domain B-0.5pts.)**

Posttest /20 Friday May 12th 2017	Time:60'	Date:

Answer the following exercises

Exercise 1 (5.5pts)   Glycemia

To determine the reaction of the hepatic cell(liver cell) and muscular cells to the pancreatic hormones, insulin and glucagon, the following experiments were carried out.

1st experiment: The concentration of hepatic glycogen(glycogen in liver) and the activity of an enzyme implicated in the hydrolysis of this glycogen were measured, following injection of glucagon. The results appear in document 1.
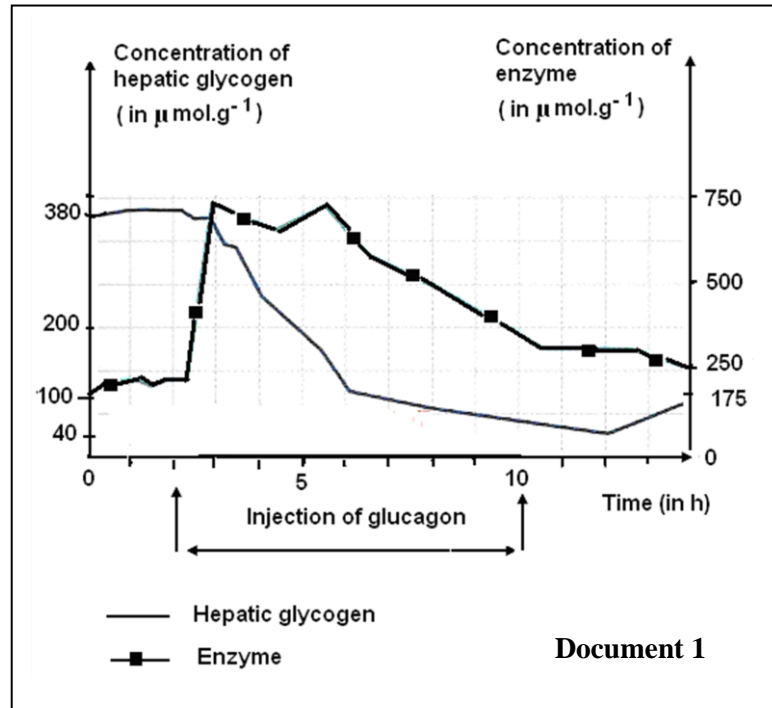
Document 1

1.Interpret the results of Document 1.
   (Domain B-1.5pts.)

2nd experiment: A muscle was placed for 10 minutes in a medium containing glucose and insulin, or glucose without insulin. Then the quantity of glucose absorbed by the muscle and the quantity of glycogen stored in the muscle in each used medium were measured. The results are shown in document 2.

2.Construct a histogram showing the results of the obtained measurements in each of the two media.**(Domain D-2pts.)**

3.1Compare these results.**(Domain B-1pt.)**

3.2 Draw out the effect of insulin on the muscle.

   (Domain B-1pt.)

	Medium without insulin	Medium with insulin
Absorbed glucose (in mg/g muscle)	1.43	1.88
Muscular glycogen (in mg/g muscle)	2.45	2.85

Document 2

**Exercise 2 (7pts)**   **Bacterial Transgenesis**

The vaccine against hepatitis B virus necessitates the production of the HBs protein found on the viral envelope. For this sake, transgenic bacteria that are capable of the of synthesizing this molecule are produced.

Document 1

Bacterium X, utilized in the transgenesis process,has a circular DNA molecule:the plasmid.Document 1 shows the plasmid,as well as of its two genes.
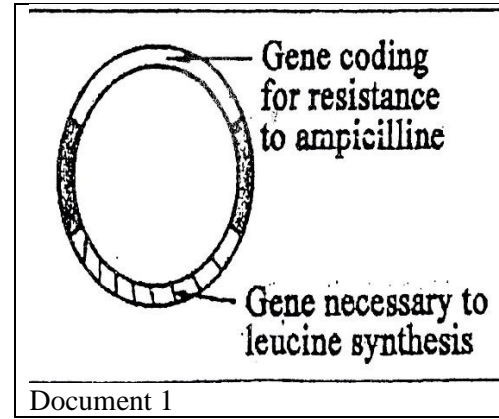
1.Draw out from Document 1the characteristic of bacterium X. **(Domain B-1pt.)**

Document 2 presents the procedure allowing the production

A plasmid was extracted from Bacterium X,is cleaved by the enzyme EcoRI.On the other hand the gene coding for HBs molecule was extracted from the plasmid of Hepatitis B virus ,was ligated to the plasmid of bacterium X to obtain plasmid Y.

Finally such plasmid was transformed into the bacterium X which multiplied to give two bacteria, bacterium A (showed positive result) and bacterium C (showed negative result).

Legend

→ Extract   ✂ Cleave by the enzyme Eco R1

Document 2

2.Schematize the steps presented in Document 2.**(Domain D-3pts.)**

3.Formulate a hypothesis that may explain the negative results shown by bacterium C.**(Domain B-2pts.)**

4.What do we call bacterium A?**(Domain A-1pt.)**

Exercise 3 (7.5pts)   **Protein Synthesis**

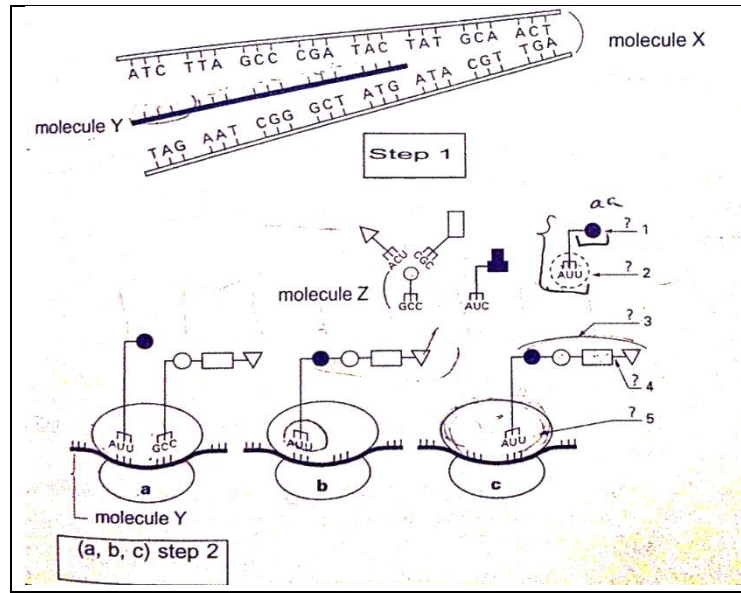Document 1 shows two moments of protein synthesis.

1. Name the molecules: X,Y &Z.
 (Domain A-1.5pts)

2. Name steps 1 & 2,then indicate their cellular locations.**(Domain A-2pts.)**

3. Complete the scheme of molecule Y.
 (Domain A-1.5pts)

Document 1

In order to identify the conditions necessary for protein synthesis, several experiments were performed that are shown in document 2.

Document 2

Tubes	Experimental conditions	Result
1	Ribosome+aminoacids mRNA+tRNA	No synthesis
2	Ribosome+aminoacids mRNA+tRNA+energy	Synthesis
3	Ribosome+aminoacids mRNA+energy	No synthesis

4.1 Analyze the results obtained.**(Domain B-1.5pts.)**

4.2 Draw out the necessary conditions for protein synthesis.**(Domain B-1pt.)**

Questionnaire

Dear students,

I am Heba Salam, a student at the Lebanese university (Faculty of education) and I'm conducting this survey for my masters thesis.

The statements included in such survey are designed only for research purpose.

It will assess your attitude toward flipped learning, that you experienced before, based on three Likret scale(Agree,Neutral and disagree).And this will provide me with the needed information to decide whether to continue with flipped learning or not, thereby enhancing the teaching learning process.

It will take you 5-7 minutes to fill such survey.I hope that you will be serious and honest enough to make the analysis of the results more confidential.

I really **thank you** for your time and for agreeing to take a part in this important survey.

Beirut, Lebanon

2016-2017

Instructions:

For each of the given statements mark the suitable opinion.

Agree: If you are convinced with the statement

Neutral: If you don't care about what is mentioned in the statement.

Disagree: If you are not convinced with the statement.

Second reminder: please be serious and honest!

Statements	Agree	Neutral	Disagree
1. The material prepared for flipped learning (FL) was organized in such a way it facilitated my understanding of the needed information.			
2. I am satisfied with FL because it made me solve many exercises related to the lesson more than I used to solve before.			
3. I like FL more than Traditional Lecture.			
4. I faced difficulty while I was studying at home because I was not used to study in advance by myself.			
5. It was time consuming while uploading the materials to be studied.			
6. Assignments in FL were too much.			
7. FL is less boring than traditional lecture.			
8. FL gives the chance for active learning via discussion with friends and question			
9. FL gives motivation to study necessary contents by oneself.			
10. I want to keep learning through Flipped classroom from time to time.			