

# Supplemental Material

*CBE—Life Sciences Education*

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## APPENDIX A

# Educational Card Games as Supplemental Materials in Learning Selected Topics in Biology

## Rationale of the Game

The game was based on from popular card games, *tong-its* and *pusoy-dos* (popular Philippine card games similar to Rummy). As in the games from which this was modeled, the object is to lay down the cards in one's hand by combining cards to form pairs, three-of-a-kind, four-of-a-kind, and so on. The major difference of this from typical card games is that each of the cards in the set contains biological term or concept to which players must form combinations which demonstrate a clear relationship between or among the terms in the included cards.

Whether a player earned points depends upon how well he can justify his combinations and the order in which he declares them to the other players. Thus, the players themselves are the referees of their game; this is an important factor in the success of the exercise since it forces the students to actively call upon their knowledge of biology rather than passively call upon their teacher for judgment.

## Goals and Objectives of the Game

The objective of this game is to foster small group discussion, problem-solving skills, and independent and active learning by applying basic biological concepts in a fun, interactive setting.

## Playing the Game

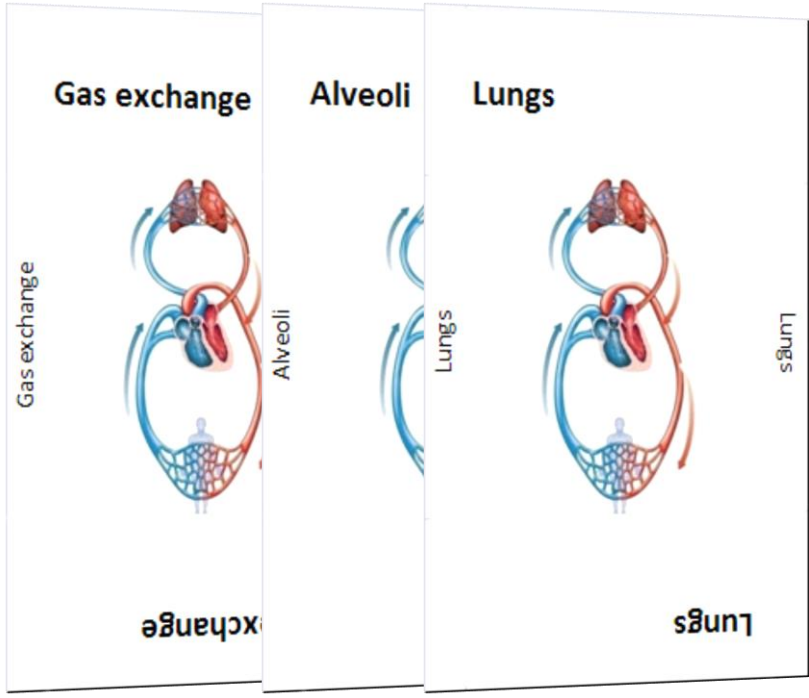
1. The game can be played with at least two players. Ideally, the game should be played by four to eight players. The group will select one player as the dealer and have him shuffle the cards and deal each player eight (8) cards.
2. The dealer then places the remaining cards face down on the center of the table. The dealer begins the game by pick the topmost card from the face-down cards, and play continues in a counter-clockwise direction.
3. The player in turn may “pass” play to the next player or declare “play” and lay down the cards which form a two up to eight card combination. It is a must that the player lay the cards down in the exact order which he claims demonstrates biological relationship, and that all cards that must be in the sequence be there.
4. Following the player's justification of his organization of cards, the other players will then decide whether or not the combination and justification is

valid. Should they unanimously approve of the cards laid down, the hand is scored as follows:

<b>SCORING SYSTEM</b>	
<b>CARD COMBINATION</b>	<b>POINTS</b>
2-card combination	2 points
3-card combination	3 points
4-card combination	4 points
5-card combination	5 points
6-card combination	6 points
7-card combination	7 points
8-card combination	8 points

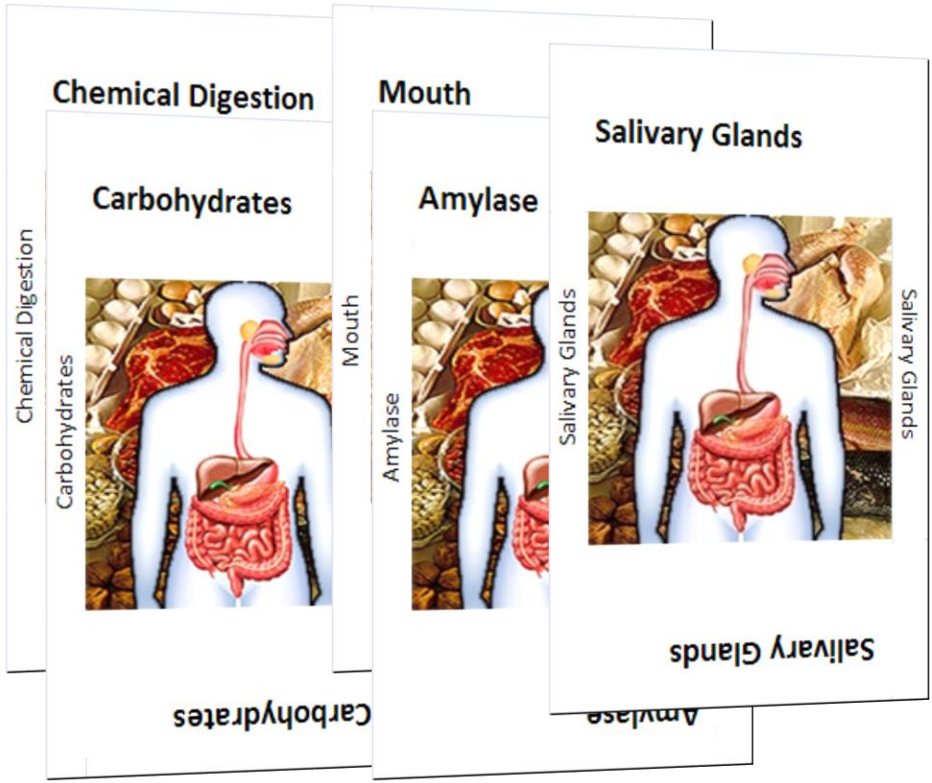
(Refer to the next page for sample card combinations and justifications.)

5. If the combination is not approved by the other players, each of the others receives one point.
6. The player then draws the number of cards he played from the remaining (face-down) cards.
7. Whether the player chooses to pass or play, he must discard one card, placing it face up on the space between him and the next player to his right. (Each player should be handling exactly eight cards throughout the game.)
8. The next player may choose the discarded card or he may select the top card from the face-down cards, depending upon potential combinations he may have in his present hand. Play continues following steps 3 through 7.
9. The turn ends when a player has already accumulated a total of fifty (50) points or when all the face-down cards have been picked up by the players.
10. The winner of the game is the player who first got fifty points or the highest scorer when all then face-down cards have been used.



Justification:  
**Gas exchange** occurs in the **alveoli** of the **lungs**.

Figure 1. Sample 3-card Combination and Justification



Justification:  
**Chemical digestion** of **carbohydrates** starts in the **mouth** through the action of **amylase** secreted by the **salivary glands**.

Figure 4. Sample 5-card Combination and Justification

## Notes to the Teachers/Users

- Please take note that this game was originally designed as a supplementary material only, preliminary discussion/knowledge of the topic is required in order to play game.
- Terms used in the game were based from the reference material the author is using for his biology class. Teachers are advised to use terms that are based from the material they are using.
- Each term was purposively repeated twice in a set of card. Duplication of the term will allow the student to use the term in more than one relationship (combination).
- To the teachers, please carefully discuss the rules of the game to your students before letting them play on their own.
- It also recommended that the first few games be done during the class schedule so that the teachers may guide their students during the play. The teacher may also play along with the students. After that, follow-up games can now be done during breaks (outside class hours), where students will play in small groups.
- It is important that the teacher encourage the students to play the game several times to realize the goals and objectives of the game. The teacher may require score sheets, pictures, and videos as evidence of students playing the game.
- Players may lessen the number of cards to fit topic/time and other limitations.
- Formulating other rules aside from the one given in this paper is also suggested so the players can play with the same cards in a different manner. Likewise, the nature of the game can also be applied to other topics in biology or other fields of discipline.

## APPENDIX B

### Evaluation Instrument for the Developed Educational Card Game

*Direction:* The following statements evaluate specific components of the games on a scale of 1 to 5. Circle the number that most accurately defines the way you feel regarding each statement.

**Scale:**

- 5 - Strongly agree
- 4 - Agree
- 3 - Fairly Agree
- 2 - Neutral
- 1 - Disagree

	Scale				
<b>Goals and objectives</b>					
1. The purpose and rationale for the game are fully explained.	5	4	3	2	1
2. The goals and objectives of the game are clearly defined.	5	4	3	2	1
3. The game was thought provoking.	5	4	3	2	1
4. The game encouraged student interaction.	5	4	3	2	1
5. The game promoted discussion of key topics.	5	4	3	2	1
6. The card game helps with my recall of concepts/terms.	5	4	3	2	1

<b>Design</b>					
7. Card-size is appropriate.	5	4	3	2	1
8. Terms printed in all four-sides of the card is a helpful feature for the player's handling of the cards.	5	4	3	2	1
9. The picture printed on the card is representative of the topic.	5	4	3	2	1
10. The material used (paper) in the preparation of the cards is durable.	5	4	3	2	1
11. The deck of card is compact and can be easily carried around.	5	4	3	2	1

<b>Components and Organization</b>					
12. The directions were clear, concise, and easily understood.	5	4	3	2	1
13. The game emphasized key points of the topic played.	5	4	3	2	1
14. The terms used were appropriate to my level of knowledge.	5	4	3	2	1
15. The number of cards was appropriate.	5	4	3	2	1
16. The length of time required to play the game is reasonable.	5	4	3	2	1

<b>Playability/Playfulness</b>					
17. The game provides opportunity for healthy competition and cooperation.	5	4	3	2	1
18. The rules of the game provide players with equal conditions for a fair play.	5	4	3	2	1
19. The rules of the game provide a set of options for flexibility in making decisions towards playing the game.	5	4	3	2	1
20. Playing the game was fun.	5	4	3	2	1

<b>Usefulness</b>					
21. The game was effective in reviewing the material.	5	4	3	2	1
22. The game encouraged the players to dig deeper into the subject matter.	5	4	3	2	1
23. Playing the game is a productive use of time.	5	4	3	2	1
24. Playing the game help me establish better relationship with the members of the group.	5	4	3	2	1
25. I would recommend the game to my peers.	5	4	3	2	1

**General comments** (Please comment on any aspect of this educational tool that you feel may contribute to its improvement)

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Name of Evaluator: \_\_\_\_\_

Course, Year and Section: \_\_\_\_\_ Signature: \_\_\_\_\_

Date: \_\_\_\_\_

## APPENDIX C

### List of Terms in the Educational Card Game

#### Nutrition and Digestion

(Alphabetical Order)

- |                                    |                                  |   |
|------------------------------------|----------------------------------|---|
| 1. Absorption                      | 32. Gallbladder                  | 63. Rectum                              |
| 2. Amino Acids                     | 33. Gastric Juice                | 64. Salivary Glands                     |
| 3. Amylase                         | 34. Glycogen                     | 65. Saturated Fats                      |
| 4. Anus                            | 35. HCl                          | 66. Serving size & number               |
| 5. Bile                            | 36. Homeostasis                  | 67. Simple Carbohydrates                |
| 6. Calcium                         | 37. Ileum                        | 68. Small Intestine                     |
| 7. calorie                         | 38. Iodine                       | 69. Sodium, Potassium                   |
| 8. Calorie                         | 39. Iron                         | 70. Sphincters                          |
| 9. Calories & Calories<br>from fat | 40. Jejunum                      | 71. Starch                              |
| 10. Carbohydrates                  | 41. Large Intestine              | 72. Stomach                             |
| 11. Cellulose                      | 42. Lining                       | 73. Sugar                               |
| 12. Chemical Digestion             | 43. Lipase                       | 74. Surface area                        |
| 13. Cholesterol                    | 44. Liver                        | 75. Teeth                               |
| 14. Chyme                          | 45. Magnesium                    | 76. Tongue                              |
| 15. Circulatory System             | 46. Maltase, Lactase,<br>Sucrase | 77. Trypsin                             |
| 16. Colon                          | 47. Meat, Eggs                   | 78. Unsaturated Fats                    |
| 17. Complex<br>Carbohydrates       | 48. Mechanical Digestion         | 79. Villi                               |
| 18. Dairy products                 | 49. Meeting nutritional<br>needs | 80. Vitamin A (retinol)                 |
| 19. Diarrhea                       | 50. Microvilli                   | 81. Vitamin B complex                   |
| 20. Dietary Fiber                  | 51. Minerals                     | 82. Vitamin C (ascorbic<br>acid)        |
| 21. Digestion                      | 52. Mouth                        | 83. Vitamin D (calciferol)              |
| 22. Digestive System               | 53. Nutrients                    | 84. Vitamin E<br>(tocopherol)           |
| 23. Duodenum                       | 54. Nutrients to limit           | 85. Vitamin K                           |
| 24. Enzymes                        | 55. Nutrients to target          | 86. Vitamins                            |
| 25. Escherichia coli               | 56. Pancreas                     | 87. Water                               |
| 26. Esophagus                      | 57. Pepsin                       | 88. Water-soluble<br>Vitamins           |
| 27. Essential Amino Acids          | 58. Peristalsis                  | 89. Whole grains, fruits,<br>vegetables |
| 28. Fats                           | 59. Pharynx                      | 90. Zinc                                |
| 29. Fat-soluble Vitamins           | 60. Phosphorous                  |   |
| 30. Feces                          | 61. Plant oils                   |   |
| 31. Food Labels                    | 62. Proteins                     |   |



## APPENDIX D

### List of Terms in the Educational Card Game

#### Respiration and Circulation

(Alphabetical Order)

- |                                       |                              |                        |
|---------------------------------------|------------------------------|------------------------|
| 1. A                                  | 35. Heart                    | 69. Right              |
| 2. Air                                | 36. Heart Attack             | 70. Septum             |
| 3. Albumin                            | 37. Hemoglobin               | 71. Sickle-cell        |
| 4. Alveoli                            | 38. Hemophilia               | 72. Sinoatrial node    |
| 5. Aorta                              | 39. Hypertension             | 73. Smoking            |
| 6. Arteriole                          | 40. Inferior vena cava       | 74. Spleen             |
| 7. Arteriosclerosis                   | 41. Inhale                   | 75. Superior vena cava |
| 8. Artery                             | 42. Interstitial fluid       | 76. Systolic           |
| 9. Asthma                             | 43. Left                     | 77. Sytemic            |
| 10. Atherosclerosis                   | 44. Lung Cancer              | 78. Thrombin           |
| 11. Atrioventricular node             | 45. Lungs                    | 79. Thymus             |
| 12. Atrium                            | 46. Lymph                    | 80. Tonsil             |
| 13. B                                 | 47. Lymphatic System         | 81. Trachea            |
| 14. Blood                             | 48. Lymphocytes              | 82. Valves             |
| 15. Bone marrow                       | 49. Medulla                  | 83. Vein               |
| 16. Breathing                         | 50. Mucus                    | 84. Ventricle          |
| 17. Bronchi                           | 51. Negative (-)             | 85. Venule             |
| 18. Bronchioles                       | 52. Nodes                    | 86. Vessels            |
| 19. Carbon dioxide (CO <sub>2</sub> ) | 53. Nose                     | 87. Waste materials    |
| 20. Carbonic acid                     | 54. Nutrients                | 88. Water vapor        |
| 21. Cardiovascular                    | 55. O                        | 89. White blood cells  |
| 22. Cilia                             | 56. Oxygen (O <sub>2</sub> ) | 90. Windpipe           |
| 23. Circulation                       | 57. Pacemaker                |                        |
| 24. Circulatory System                | 58. Plasma                   |                        |
| 25. Clot                              | 59. Platelet                 |                        |
| 26. Cystic Fibrosis                   | 60. Poor                     |                        |
| 27. Diastolic                         | 61. Positive (+)             |                        |
| 28. Diffuse                           | 62. Pressure                 |                        |
| 29. Emphysema                         | 63. Prothrombin              |                        |
| 30. Epiglottis                        | 64. Pulmonary                |                        |
| 31. Exhale                            | 65. Red Blood Cells          |                        |
| 32. Fibrin                            | 66. Respiratory System       |                        |
| 33. Fibrinogen                        | 67. Rh factor                |                        |
| 34. Gas exchange                      | 68. Rich                     |                        |

APPENDIX E

**Descriptive Measures of the IQ Scores of the Students  
in the Experimental and Control Groups**

EXPERIMENTAL GROUP				
Student	Age	Raw Score	IQ Score	Verbal Description
1	16	57	115	Above Average
2	42	52	110	Average
3	17	51	109	Average
4	17	49	107	Average
5	16	48	106	Average
6	16	48	106	Average
7	19	47	105	Average
8	17	46	104	Average
9	16	46	104	Average
10	16	46	104	Average
11	17	45	103	Average
12	20	44	102	Average
13	19	44	102	Average
14	17	44	102	Average
15	16	44	102	Average
16	16	43	101	Average
17	17	43	101	Average
18	17	42	100	Average
19	16	41	99	Average
20	18	41	99	Average
21	17	41	99	Average
22	22	40	98	Average
23	15	40	98	Average
24	16	39	97	Average
25	16	38	96	Average
26	18	38	96	Average
27	20	38	96	Average
28	16	36	94	Average
29	17	36	94	Average
30	23	36	94	Average
31	16	35	93	Average
32	16	35	93	Average
33	16	34	92	Average
34	16	33	91	Average
35	20	32	90	Average
36	23	32	90	Average
37	17	32	90	Average
38	18	28	86	Below Average
39	16	27	85	Below Average
40	17	18	76	Poor
<b>Mean IQ Score</b>			<b>98.225</b>	<b>Average</b>
<b>Standard Deviation</b>			<b>7.540</b>	

CONTROL GROUP				
Student	Age	Raw Score	IQ Score	Verbal Description
1	16	55	113	Above Average
2	18	51	109	Average
3	16	49	107	Average
4	16	48	106	Average
5	16	48	106	Average
6	19	46	104	Average
7	18	45	103	Average
8	17	45	103	Average
9	16	44	102	Average
10	16	44	102	Average
11	18	43	101	Average
12	18	43	101	Average
13	16	42	100	Average
14	16	42	100	Average
15	16	42	100	Average
16	17	41	99	Average
17	18	41	99	Average
18	21	41	99	Average
19	16	41	99	Average
20	16	40	98	Average
21	16	39	97	Average
22	20	39	97	Average
23	17	39	97	Average
24	17	38	96	Average
25	17	38	96	Average
26	16	38	96	Average
27	16	38	96	Average
28	16	37	95	Average
29	16	36	94	Average
30	18	36	94	Average
31	20	37	94	Average
32	16	34	92	Average
33	16	32	90	Average
34	16	31	89	Below Average
35	16	30	88	Below Average
36	17	29	87	Below Average
37	16	29	87	Below Average
38	16	28	86	Below Average
39	17	26	84	Below Average
40	21	24	82	Below Average
<b>Mean IQ Score</b>			<b>97.200</b>	<b>Average</b>
<b>Standard Deviation</b>			<b>6.936</b>	

APPENDIX F

**Pretest, Posttest, and Gain Scores of the Experimental and Control Groups**

Student	EXPERIMENTAL GROUP			CONTROL GROUP		
	Post Test	Pretest	Gain Score	Post Test	Pretest	Gain Score
	Score (50)	Score (50)		Score (50)	Score (50)	
1	40	17	23	43	31	12
2	36	14	22	38	17	21
3	41	20	21	43	22	21
4	42	22	20	33	13	20
5	38	18	20	37	19	18
6	38	18	20	40	23	17
7	39	20	19	43	27	16
8	39	20	19	38	22	16
9	45	27	18	27	11	16
10	31	14	17	33	18	15
11	40	23	17	28	14	14
12	33	17	16	33	20	13
13	37	21	16	29	16	13
14	32	17	15	32	19	13
15	33	18	15	25	13	12
16	35	20	15	32	20	12
17	34	19	15	31	19	12
18	39	26	13	20	8	12
19	36	23	13	26	16	10
20	26	14	12	32	22	10
21	41	29	12	28	19	9
22	30	18	12	25	17	8
23	30	18	12	28	20	8
24	27	16	11	23	16	7
25	33	22	11	21	14	7
26	29	18	11	30	24	6
27	27	17	10	31	25	6
28	28	18	10	22	16	6
29	25	15	10	25	20	5
30	22	12	10	30	26	4
31	34	25	9	23	19	4
32	36	28	8	23	20	3
33	27	20	7	20	17	3
34	27	20	7	23	20	3
35	27	20	7	27	25	2
36	25	21	4	22	21	1
37	33	29	4	16	15	1
38	28	24	4	20	20	0
39	25	22	3	23	23	0
40	19	20	-1	15	22	-7
<b>Mean</b>	<b>32.675</b>	<b>20</b>	<b>12.675</b>	<b>28.45</b>	<b>19.225</b>	<b>9.225</b>
<b>StDev</b>	<b>6.162</b>	<b>4.120</b>	<b>5.753</b>	<b>7.207</b>	<b>4.538</b>	<b>6.526</b>

## APPENDIX G

### **Students' Comments on the Developed Educational Card Games**

1. Uhm.. For me, the card game is enough in all aspects, and I'm satisfied with that.
2. Playing the game helped me to recall the given topics and improve my social skill among my classmates.
3. Playing the game is a combination of having fun and acquiring knowledge. It's very helpful for me.
4. Playing the card game was fun and it helps me understand the lesson. The game also makes me to have a good relationship with my groupmates.
5. I recommend stating the directions (rules and regulations) more clearly, so that players may not be confused.
6. Playing the card game gives another way of reviewing important topics in this subject. Even the smallest detail should be answered and connected to earn points.
7. The card game was very effective for me to review the lesson.
8. The game was so fun and fruitful. It helped me to enhance my memory, to remember the terms to consider in our topic.
9. Because of this educational tool, I learned how to communicate and to be responsible to my groupmates. As a matter of fact, on this game, I learned to use my vacant time.
10. As far as it seems, everything in this card game are just good and suitable enough for student to understand it. Maybe just enhance the color of the picture and text printed on the cards. This game enhanced my knowledge on the two topics and I had fun playing the cards.
11. I am hoping for a longer time to play.
12. This educational tool can be of help to improve knowledge about the topic. It helps us to recall the concepts and terms.

13. The game was fun but quite boring if you are not familiar to the word used in the game. It helped me to widen my vocabulary, and to my conclusion, it is effective enough to enrich our knowledge about the subject matter.
14. The game is challenging and fun. In my experience, I truly find it hard thinking and deciding for the right combinations. It would be better if one will review the topic and know the rules for you to make the right move. I don't comprehensively understand the rules so I miss some chances to drop combination cards. But over-all, it's very effective and good.
15. This game was really good. It helps me think and recall the topic. I had fun and also I had gained knowledge.
16. The game is nice and enjoyable.
17. Playing the game is fun. There are a lot of things that you will know when you play the game. It's effective in reviewing the lesson, and it helps to establish our relationship with our classmates.
18. We were encouraged to review the lesson so as to play the game right. I really enjoyed playing this game.
19. Playing the educational card game gives me more learning about biology. And it was fun playing the game.
20. It is a helpful tool in reviewing the lesson. I enjoyed playing the game.
21. I think the picture should match the term written on it. In this way, we will also be aware or familiar with how that particular term looks like.
22. The cards help us to review the topic by playing it. This educational tool must be used too by other students so they can easily learn and review other topics.
23. I think it would be helpful if each card has a specific picture. For example, if the word is lungs, the picture must be the lungs so that we can be familiar of how look like.
24. I can say that the game improved my knowledge, cooperation, alertness and relationship with my co-members. Two thumbs up for this game!

25. The game is very educational. It also improved the relationship between the leader and his members. I feel pressured with the time limit, but it's okay to me because I also enjoy it.
26. Overall, it's good and fun.
27. It helps very well. It makes our mind crazy. It's effective in reviewing the material and it helps us establish our relationship with our classmates.
28. The card game is a very useful tool for the students to have a good recall of the topic. As I experienced, interacting with my groupmates made me share my own thoughts and idea fairly with them.
29. It's nice, very challenging, exciting, and encouraging to learn more about the topic. It is also a way of recalling or reviewing the past lessons. I like it.
30. I can say that I enjoy playing this game and it is effective to review our past lesson. It helps me to easily understand our lesson and it gives us time to have a better relationship with our groupmates and classmates.
31. This card game is very applicable in studying. It has many advantages like recalling the concepts and terms and getting more knowledge. It is grateful to have this educational card to a student like me.
32. It helps the students to have a review of the topic while playing.
33. It is challenging. It enhances my memory. It challenges every student to understand the topic.
34. The educational tool that we played is challenging because we need to think. We had fun and we build friendship.
35. This is really a big help for increasing my knowledge.
36. The card game helps us to know more about our body parts and it help us to have confidence while defending our answer.
37. The game was nice and fun. It was so educational that it can help us in developing our knowledge and stock more information about the topic.

38. This kind of educational game was very enjoyable, yet at the same time we learn while we are having fun. It's like we are playing the usual deck of cards but it is more tricky to play it because it has a confusing set of rules. But I much enjoy playing the game because it helps me review the topic.
39. The game was so interesting. It helps us to review our topic. It also developed our cooperative skills. And we think deeper on how to depend on our card combinations. The educational game was fun and it's enjoyable.
40. I like the game because it can help us by means of simply reviewing the lessons, giving extra information and having a good relation with the other players.
41. It was nice, fun, and we have used our time productively. The game is appropriate for us, students.

## APPENDIX H

### **Subject Matter Experts' Comments on the Developed Educational Card Games**

1. The material is very good especially for students who would like to have a different approach in the classroom.
2. My only comment is on the playability aspect. The fact that the game is subjective makes it quite difficult to earn points. Especially if the students/players are grade/point conscious.
3. The game encourages students' critical thinking.
4. I find the game time consuming. Maybe it could be better if the number of cards will be limited.
5. The game is thought provoking and encourages the player to recall certain concepts, but it's a bit time consuming. It would be better if the number of cards to be used is playable within a certain period of time.
6. The card game is intended for fast learners, but it will help evaluate students' understanding about the topic. It is time consuming. The length of time in playing the cards should be given.
7. The game is time consuming and it requires a creative/higher-thinking for the students.
8. This playing card is educational and effective. At what grade or year should be the students required to play this game? I think some of the terms are not yet applicable to elementary graders.