

## ANCAT: An Autonomous Learning Card Kit to Help Students Write Ionic Formula

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**ABSTRACT:** The fundamental of introductory chemistry is formula writing. The basic requirements of high school chemistry subjects are writing chemical formulas, including writing an ionic formula. Students require good practice and knowledge of the formula and charge of the ions to write the ionic formula and name the ionic compound. A set of cards called "Ancat" consists of the basic atom of the ion on one side, and on the reverse side is the name and formula of the ions. The set of cards comprises the anion and cation cards distinguished by color. High school students would use these cards as a self-directed learning tool. As a self-directed learning tool, students will construct the ionic formula using the card; then, write the formula and vice-versa. By using the cards, students will be able to identify the symbol of each ion, the charge of each ion, the name of the ions, determine the correct formula of each ionic compound by considering the total charge of an ionic compound is zero, and learn the name of the ionic compound. Teachers can replace the traditional homework with this ductile method that can aid motivation in students; besides that, these cards are suitable for blended learning tools in the classroom.

### GRAPHICAL ABSTRACT



**KEYWORDS:** Distance Learning / Self Instruction, High School / Introductory Chemistry, Hands-On Learning / Manipulatives, Inorganic Chemistry, Ionic Bonding, Physical Chemistry, Student-Centered Learning, Testing / Assessment, Nomenclature / Units / Symbols.

The set of cards to practice ionic formula writing allows students to construct the ionic formula actively. Autonomous learning, according to Pintrich, 2000 is an active and constructive process. Independent learners can take control of their learning where they are goal oriented.<sup>2</sup> Students using "Ancat" will have guidance in writing ionic formula in a provided worksheet after constructing the ionic formula based on the scaffolding provided by the "Constructing Ionic Formula Guide." The "Constructing Ionic Formula Guide" provides the basic principles of writing an ionic formula: the total charge in an ionic compound should be zero, and polyatomic ions need to be in brackets if there are more than two ions present in the formula. The positive ions come before the negative ions. After going through the guide, the students will process with the activity sheet provided. In each activity sheet, students will need to state the time completion for the activity after the activity; students will refer to the answer sheet to self-check the answers. The goal is to achieve more correct answers in the shortest possible time. Students may repeat the activity to challenge themselves to achieve better timing and the right formula. Students utilize the same worksheet to accomplish the goal of getting all the formulas correct. The teacher will set the timing. There will be two different types of worksheets; one is to construct the formula from the name the other is to name the formula.

## ACTIVITY PREPARATION

Each student uses one set of ionic cards comprising positive and negative ions, numbers 3 and 2, and brackets. The ions will have two sides printed. One is the atomic formula and name, and the other is the ionic formula and its name (Figure 1). The word of both atom and ions are translated to Bahasa Malaysia to suit students studying chemistry in English and Bahasa Malaysia. The cards can be printed using office paper and cut to fit the size. Then, paste the two printed sides using tape to get the cards with the atom and ions on a single card. A list with the formula of the ions, Constructing Ionic Formula Guide, suggested worksheets, and answer sheet is given as Supporting Information.

## RULES OF THE ACTIVITY

Before starting the activity, students will need to go through the "Constructing Ionic Formula Guide" sheet first. This worksheet can be an explainer video or audio. Once the students go through the sheet, the students will group the given card into positive and negative ions. Once grouped, students will go through each ion themselves, familiarizing themselves with the ion's charge, symbol, and name. After that, students will attempt to construct the formula based on the examples in the guide. Once the students understand the concept, they will answer the first worksheet. The students will repeat the process until they accomplish satisfactory results. Once achieved, they will attempt the second worksheet.

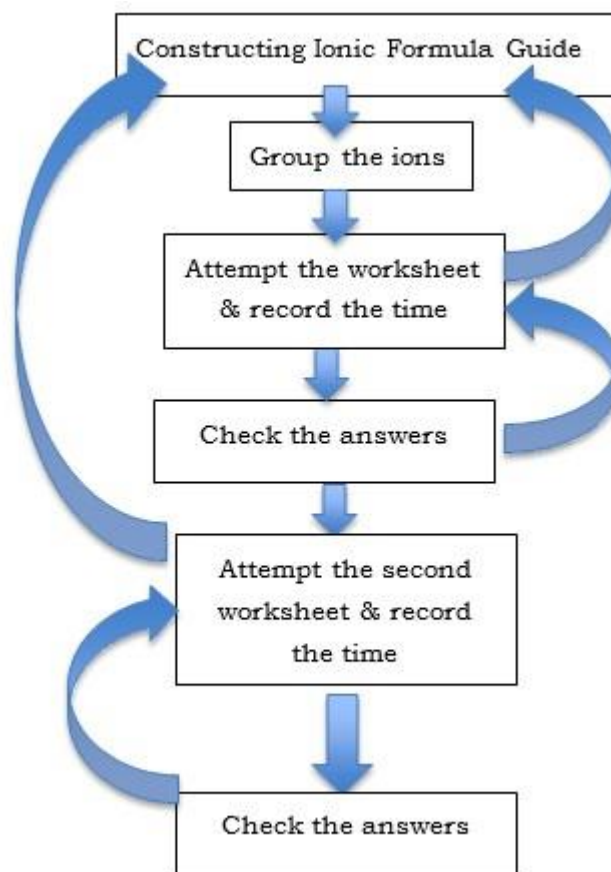


Figure 2: The activity process by the students

## VARIATION

A teacher has a choice to conduct this activity using blended learning. Students will go through the Constructing Ionic Formula Guide for blended learning and group the ions at home. The activity sheet will be the collaborative activity in the classroom. For a better understanding teacher can consider making an explainer video for students to use at home.



## DISCUSSION

There is at least three other chemical formula activity that has been reported in this journal.<sup>1,3,5</sup> All the activities are for constructing chemical formulas using games. All the activities were game-based to construct formulas. Compared to this activity which is more self-paced where students will be able to learn according to their own speed. In contrast, one gamed-based activity showed no significant difference in using the card game to understand chemical formulas.<sup>5</sup> Apart from that the game-based activity proposed is suitable for university and college students.<sup>1,3,5</sup>

"Ancat" was made simple with basic and common ions to foster a basic understanding for high school students to write ionic formulas. This will build up the confidence of students conducting the activity as it is made based on the current Malaysian school curriculum and standards. The activity was well-received among students and teachers who used the card. Students' feedbacks were positive towards the activity cards. Teachers from secondary schools on the other hand mentioned positive outcomes in ionic formula writing.

## ASSOCIATED CONTENT

Supporting Information

[https://drive.google.com/drive/folders/18XdtSJ6t1w\\_8a-sqsh67RgwqEapxtFRV?usp=sharing](https://drive.google.com/drive/folders/18XdtSJ6t1w_8a-sqsh67RgwqEapxtFRV?usp=sharing)

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