The Development of Chemo-entrepreneurship Oriented Material Books to Analyze Cognitive Abilities of Grade 10 Students in Redox Reaction

Maula Najikh Wildana[1*], Sri Susilogati Sumarti[2], Endang Susilaningsih[2]

[1]Universitas Negeri Semarang, Postgraduate Chemistry Education, Indonesia

[2]Universitas Negeri Semarang, Department of Chemistry, Indonesia
* Corresponding Author: wildan_mn@students.unnes.ac.id

Abstract. The aim of this research is to develop chemo-entrepreneurship-oriented teaching materials that appropriate and effective to analyze students' cognitive ability. This is Research and Development method with ADDIE model design. Subjects were students of class X MIPA 1 Madrasah Aliyah Negeri 1 in Semarang City. The research was started out from January to May 2021. Data collection methods are by observation, questionnaires, tests, and project methods. The instrument used include interview sheets, instrument validation sheets, questionnaire responses, and cognitive evaluation instruments. Data analysis techniques include analysis of interview sheets, instrument validation, analysis of the effectiveness of teaching materials, and analysis of questionnaire responses. The results is an appropriate and effective CEP-oriented teaching materials that used to teach in corona virus pandemic era. Teaching materials get an average validation score of 49 out of 52. Teaching materials also get positive responses from teachers with score 35 out of 40 and positive responses from students with an average score of 38.53 out of 48. The results also mention good cognitive abilities of students where 26 of 30 students or 87% students passed the minimum score, the highest score was 87, the lowest score was 53, and the average score was 75. It means that developed material book have a good score and effective to help teacher explain chemistry with interdisciplinary approaches.

Key words: material books; chemo-entrepreneurship; redox reaction; interdisciplinary.

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INTRODUCTION

The Indonesian Central Bureau of Statistics in 2015, 2016, and 2017 noted that every year there is an increase in workers with high school graduates, which are approximately eight hundred thousand people and vocational graduates, which are almost one million people (Badan Pusat Statistik, 2016, 2017). The data shows that there is an increase in workers graduating from SMA and SMK, while employment opportunities are getting tighter due to the high competitiveness in screening prospective workers. The lack of employment opportunities makes some people open entrepreneurial activities. Entrepreneurial activity is a form of innovation to make a product or service of economic value. The Ministry of Cooperatives notes that the number of Micro, Small and Medium Enterprises (UMKM) has increased relative to each year from 2016 to 2018, which is approximately one million and two hundred new businesses (Depkop, 2017, 2018). This increase in the number of UMKMs shows that the community has an interest in entrepreneurial activities which continues to increase every year. The increase in entrepreneurial activities results in increasingly fierce product competition, so there is a need for learning about entrepreneurship. Learning about entrepreneurship can be given to students as a debriefing in the form of entrepreneurial skills that provide a lot of experience and benefits for students.

The orientation of chemistry education is now starting to develop students' thinking skills, namely by connecting chemistry with other materials or other disciplines where students hope that they will be able to help solve global problems (Nagarajan & Overton, 2019). Entrepreneurship-oriented chemistry learning or chemo-entrepreneurship is one of the chemical learning methods that aims to motivate students to think creatively through scientific project activities that produce an innovative entrepreneurial work (Supartono, 2006). The experimental method in a project can motivate students about how the knowledge they gain can be formed and synergized (Joyce et al., 2015). Entrepreneurial activities in chemistry learning can develop students' creativity and cause active classroom conditions, so that learning becomes

more concerned (Wibowo & Ariyatun, 2018), while at the same time attracting students' interest in the world of entrepreneurship (Arieska & Kamaludin, 2018).

Learning can run well if there are teachers (teachers) and the right learning components, one of which is the availability of appropriate books or teaching materials. Teaching materials are learning aids that contain the application of science, information, and examples of the application of science in everyday life that can be used in the classroom or at home (Arsyad, 2011). Transfer of knowledge through teaching materials depends on how students can understand the material provided by teaching materials (Rizqiana et al., 2017). So, it is necessary to have an appropriate teaching material so that learning material can be easily accepted by students. Good teaching materials have several components, including cover pages, identity, introduction, table of contents, instructions for using books, basic competencies and indicators, concept maps, materials, assignments, summaries, evaluations, and closings (Arieska & Kamaludin, 2018).

Field study in Madrasah Aliyah 1 Kota Semarang told that learning still need to be studied because students haven't reached the minimum standard. Only 9 students from 30 in the X MIPA 1 that reached the minimum standard in the daily test. There should be a problem that made students not complete the minimum standard. Also, they are don't have creativity evaluation, so it should be the problem because students don't have enough creativity to develop on the main material, then they are didn't respectful to the material. So the development of entrepreneurship oriented learning was needed to build students creativity (Afwa et al., 2018).

Field study in Madrasah Aliyah 1 Kota Semarang also shows that chemistry teachers haven't develop their learning materials. Learning material that used by teachers is the learning material provided by school and government. It wouldn't fit the student's ability because of generalization in the Semarang City. It would better to develop their learning materials based on what teachers and curriculum want from students (Nurbaeti, 2019).

Based on the above gaps, it is necessary to develop a lesson, manual, or reference that can be used to improve the quality of human resources in entrepreneurship activities. The development of teaching materials can also be used as a basis for knowledge to start a business. It can even be used as a training and evaluation of students' entrepreneurial skills.

METHOD

Research Goal

The aim of the research is to develop an appropriate chemo entrepreneurship-oriented material book or teaching materials and to analyze students' cognitive ability.

Sample and Data Collection

The research method is research and development by following the ADDIE model development research design with five stages (Dick et al., 2008). The research stages include: (1) the analysis phase, (2) the design phase, (3) the development phase, (4) the implementation phase, and (5) the evaluation phase. The research location was carried out at Madrasah Aliyah Negeri 1 Kota Semarang from January to May 2021. The research subjects consisted of teachers, students of class X MIPA 1, and expert validators.

Analyzing of Data

The ADDIE research procedure has been modified so that each stage has an evaluation session. Evaluation is used to correct deficiencies at each stage (Dick et al., 2008). The analysis phase begins with field observations through interviews. The results of the interviews are used for problem and needs analysis. The design phase begins with determining the research subject matter, making a research flow chart, and assessing the concept of teaching materials developed. The topic of discussion is the topic of redox reactions and the nomenclature of chemical compounds for class x in even semesters. The research flow chart is designed according to the research flow, starting from field observations, analysis of problems and needs, the process of designing teaching materials products, product validation and testing processes, product implementation, data analysis of research results, and drawing conclusions. The development phase begins with designing the concept of teaching materials, designing syllabus, lesson plans, and evaluation tools, validation processes, and the trial phase. The design of teaching materials and other devices is validated by experts to assess the feasibility of the design of teaching materials before the trial. The design of teaching materials that have been declared feasible to be tested to get input so that they can be improved before the implementation stage is carried out. The implementation stage is the stage of applying

teaching materials to research subjects, namely students of class X MIPA 1. Learning is carried out using the project method that produces products. Entrepreneurship projects are planned and designed by students whose output is in the form of value-added entrepreneurial products related to redox reactions. Then in the last meeting, students had a daily test. The result of daily test used to analyze students' cognitive ability from the learning. The evaluation stage is used as an evaluation of each stage, besides that it is also a stage to find out the strengths and weaknesses of chemo-entrepreneurship-oriented teaching materials that were developed based on the responses of students and teachers as users through a response questionnaire.

The instruments used in the study included teacher and student interview guide sheets, teaching materials instruments, syllabus, and lesson plans, instrument validation sheets, questionnaire responses, and daily test sheets. The effectiveness of teaching materials is seen from the analysis of the daily test of students. Teaching materials are declared effective if: (1) 80% of students in the classroom complete the test with minimum score is 70 from 100, and (2) users of teaching materials including teachers and students give positive responses with a percentage of more than equal to 80% (Aliyah et al., 2018).

RESULTS AND DISCUSSION

Based on the results of research that has been carried out at the analysis stage, the teacher stated that the teaching materials used were still using textbooks provided by the school, but other learning media on the internet were also used by teachers in distance learning during the pandemic. The teacher stated that there were still some students who had not completed the daily test. The teacher also stated that effective learning applied during the pandemic was discussion learning through video calls due to the lack of activeness of students in discussions if only using WhatsApp message media. The teacher also states that the skills and skills expected of graduate students are independent, competitive in the world of work, and creative in entrepreneurship. Meanwhile, students stated that the chemistry material could be understood easily, and the lesson was fun. Students also prefer to study in groups. Students do not know and are not interested in the world of entrepreneurship, but they state that entrepreneurial people are creative people, so the research was conducted as an introduction to entrepreneurship activities through chemistry learning.

The results of observations made in the field by reviewing the chemistry learning process directly found that students tend to be more passive in class when learning is only done with WhatsApp messages, but students tend to be more active in class using teleconferencing media. So that the researcher concludes that the material can be maximized if it is delivered with the help of teleconferencing. The results of the literature review in the form of data on the results of test scores X MIPA 1 in the previous material showed in Table 1 also concluded that many students had not completed the KKM, namely those with scores below 70.

Table 1. Data Result of Daily Test X MIPA 1 Previous Material

Subject	Score	Subject	Score
S-01	75	S-16	63
S-02	84	S-17	65
S-03	49	S-18	64
S-04	50	S-19	69
S-05	51	S-20	68
S-06	52	S-21	70
S-07	72	S-22	57
S-08	55	S-23	72
S-09	55	S-24	54
S-10	70	S-25	68
S-11	57	S-26	70
S-12	55	S-27	75
S-13	60	S-28	73
S-14	60	S-29	48
S-15	63	S-30	47

The data on the daily test scores of students in class X MIPA 1 is still low because there are only 9 out of 30 students who complete the KKM. This shows that there is a lack of mastery of students' material, so there needs to be a learning that has a positive effect on students' understanding, one of which is the development of CEP chemistry learning aids (Afwa et al., 2018).

The design stage is carried out in determining the research subject and making research flow diagrams. The subject matter used is Redox material and Nomenclature of Chemical Compounds. Basic competencies were obtained from the high school chemistry syllabus by the 2016 Ministry of Education and Culture (Kemendikbud, 2016). Indicators of competency achievement are developed from basic competencies by taking some skills from

entrepreneurial attitudes. The flow chart developed includes the preparation of components of teaching materials, collection of materials and chemical concepts, collection of chemo-entrepreneurship materials, and development of teaching materials designs. The flow chart for the development of chemo-entrepreneurship-oriented teaching materials is shown in Figure 1.

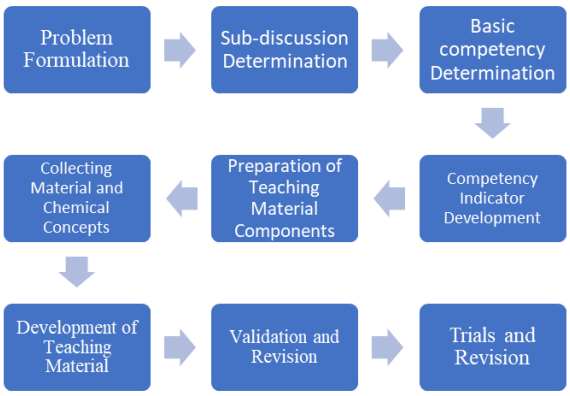


Figure 1. Flowchart of CEP-Oriented Teaching Material Development

The development stage starts from making the design of teaching materials, making the design of supporting instruments, making the instrument validation sheet, the instrument validation stage, and the trial stage. Making teaching material instruments starts from the preparation of teaching materials. The components of teaching materials used refer to the development of teaching materials by the Ministry of National Education and Arieska and Kamaludin, including title pages, introductions, table of contents, instructions for use, competencies, concept maps, core materials and chemo-entrepreneurship materials, assignments, and closing pages (Arieska & Kamaludin, 2018; Depdiknas, 2008). The creation of teaching material content uses the Microsoft Word 2016 application while the design uses the 2018 Corel Draw application. The teaching materials are then converted into *.pdf extensions to make their compatibility wider because they can be accessed by more devices through laptop and smartphone browsers, and can overcome distribution limitations. teaching materials. The application of electronic teaching materials in learning is one of the efforts to overcome the problem of limited printed teaching materials (Meek et al., 2016). The display of the developed teaching materials is presented in Figure 2a and the display when used is shown in Figure 2b.

Figure 2a. Teaching Materials

Figure 2b. Display of Teaching Materials When Used

The teaching materials that have been designed are then validated by three expert validators to assess the product before testing the product. Aspects measured include material aspects, display aspects, aspects and chemo-entrepreneurship. The assessment is carried out through 13 statement items, including: (1) the suitability of the material on the basic competencies and core competencies, (2) the accuracy or suitability of the material with facts, concepts, and does not cause double interpretations, (3) the latest material on the development of chemistry, actualization events presented, and the use of factual illustrations, (4) presentation techniques include coherence, introduction before the material, and a summary at the end of the material, (5) in accordance with the rules of sentence structure accuracy, sentence effectiveness, sentence standardity, and clear delivery of information, (6) straightforward and communicative covering the accuracy of the use

of spelling, punctuation, and being able to encourage students to learn the material, (7) the completeness of the components of teaching materials, (8) display quality includes design and layout, (9) the presentation system, namely the coherence of the material from easy to difficult, there are examples of questions, and placement of assignments, (10) accuracy of graphics includes color accuracy in sample images, picture descriptions bars, and the placement of illustrations that do not interfere, (11) the effectiveness of teaching materials in providing entrepreneurial motivation through chemo-entrepreneurship learning, (12) components of teaching materials with a chemo-entrepreneurship orientation, (13) contextualization of events presented in teaching materials. The results of the validation carried out by three experts are presented in Table 2.

Table 2. Expert Validation Score of Teaching Material Instruments

Number	Validator Code	Total Score	Criteria
1	VT-1	49	Very valid
2	VT-2	50	Very valid
3	VT-3	48	Very valid

The teaching material instrument was declared to meet the very valid criteria by validator 1, validator 2, and validator 3. The teaching material instrument can be used for testing with an average score of 49 out of 52 which is included in the very valid criteria. The revisions to the teaching material instruments developed according to suggestions from expert validators include changes in the title page design, changes in the contents of the instructions for using teaching materials which are changed to be more descriptive and contain instructions for teachers as well as instructions for students, giving boxes as a differentiator between content sections with assignments, and adding practice questions to hone students' abilities.

Teaching materials that have gone through the validation and revision stages according to expert advice are then tested before the implementation stage. The trial was carried out in class XI MIPA 4 and the results obtained were in the form of input that must be improved again before the implementation stage. The input given was obtained from a test questionnaire which included 10 statements, including: (1) how easy it is to understand chemistry through the developed teaching materials, (2) the clarity and legibility of letters, numbers, and symbols in the teaching materials, (3) attractiveness of the design of teaching materials developed, (4) attractiveness of delivering material in teaching materials, (5) attractiveness of existing entrepreneurial materials in teaching materials, (6) attractiveness of teaching materials in making students creative entrepreneurship, (7) contextuality (can be found in the surrounding life) illustrations and entrepreneurial stories presented in teaching materials, (8) the attractiveness of project learning in teaching materials in making students confident and flexible in group discussions, (9) students' interest in developing creative ideas, and (10) the relationship between entrepreneurship material and chemistry. The results of the trial questionnaire are shown in Figure 3.

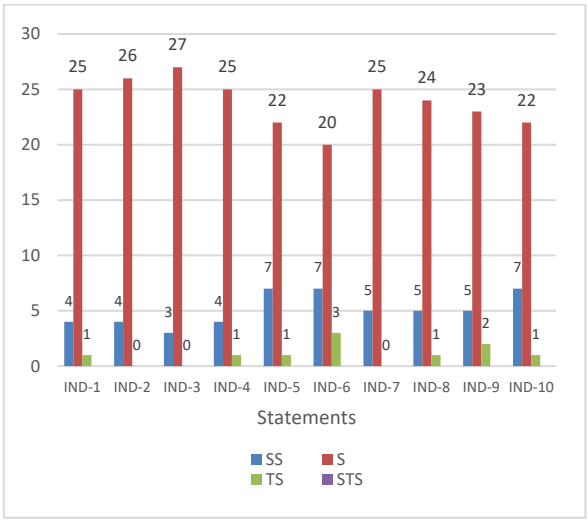


Figure 3. Results of Questionnaire Responses for Teaching Materials Test

The results of the test response questionnaire analysis showed that students tended to answer agreeable statements, followed by strongly agree answers, and some answered disagreed with the statements given. The first statement was answered by students with 4 answers strongly agree, 25 answers agreed, and 1 answer disagreed. The second statement was answered by students with 4 answers strongly agree and 26 answers agree. The third statement was answered by students with 3 answers strongly agree and 27 answers agree. The fourth statement was answered by students with 4 answers strongly agree, 25 answers agreed, and 1 answer disagreed. The fifth statement was answered by students with 7 answers strongly agree, 22

answers agreed, and 1 answer disagreed. The sixth statement was answered by students with 7 answers strongly agree, 20 answers agree, and 3 answers disagree. The seventh statement was answered by students with 5 answers strongly agree and 25 answers agree. The eighth statement was answered by students with 5 answers strongly agree, 24 answers agreed, and 1 answer disagreed. The ninth statement was answered by students with 5 answers strongly agree, 23 answers agree, and 2 answers disagree. The tenth statement was answered by students with 7 answers strongly agree, 22 answers agreed, and 1 answer disagreed.

The average response score for the trial phase was 31.36 from the maximum score of 40. The test got a percentage of 78.41% and was categorized in the "good" criteria. As for the input to the teaching materials developed at the trial stage, among others: pictures and examples are reproduced to make the teaching materials even more interesting, add cartoon or animated illustrations so that they are more interesting to read and make students understand the topics being taught more quickly, multiply stories. inspirational about entrepreneurs to build students' creative ideas in entrepreneurship, adding animation and entertainment to make learning more interesting.

The implementation phase was carried out on 30 students of class X MIPA 1. The implementation phase was carried out face-to-face with the help of the Google Meet teleconferencing application because it was still in the Covid-19 pandemic. Students are allowed to use chemo-entrepreneurship-oriented teaching materials that are developed outside of learning. The research activity was carried out for five meetings. The first to fourth meetings are used for learning activities and the fifth meetings' used for daily test. Learning chemo entrepreneurship is carried out through project activities that produce entrepreneurial products (Sumarti et al., 2014).

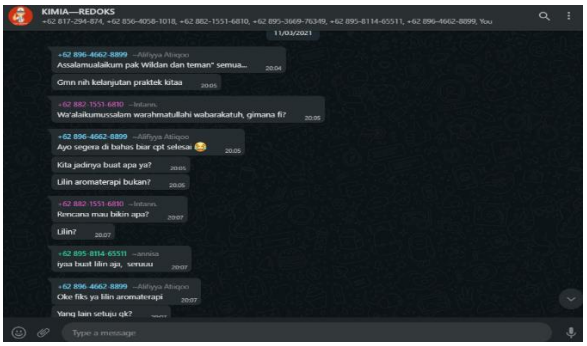
The learning process is first carried out by introducing teaching materials and ensuring that all students have received the teaching materials. Teaching materials are used during the learning process. Assignments are given at the end of the meeting. The assignments given are in the form of questions and project assignments for making entrepreneurial products. Learning is done with students studying in groups. Learning in groups can create interdisciplinary collaboration between students so that students can train collaboration such as scientists and product designers in making an efficient product (Bouldin & Wagner, 2019).

The students in the implementation class were divided into 5 groups consisting of 6 students in each group. The first assignment is the formulation of ideas and ideas about events related to redox reactions. Students are freed to arrange problems that arise from or as a result of redox reactions, then students develop solutions. Assignments made by students generate ideas and ideas about events and problems related to redox and can be related to the manufacture of a product.

The second assignment is product manufacturing planning. Students are asked to discuss to produce solutions to problems that were raised at the previous meeting. Students are directed to compile tools and materials as well as work steps to make an entrepreneurial product. Students are free to look for references in books and the internet. The result of this assignment is to produce an article containing the background of the problem, the emergence of ideas, tools and materials, as well as work steps to create entrepreneurial products that solve these problems.

The third assignment is to make a short video about making products from the projects being worked on. Students are also asked to promote and sell products to find out the response from buyers to the products made. Videos of product making made by students are then assessed to analyze the entrepreneurial creativity of students.

The learning that has been carried out has been running smoothly and there is a lot of discussion. Students are active in learning in terms of activeness in answering questions and exercises given by the teacher. Students are also not shy in asking about difficulties in learning. Students are confident in conveying their answers when asked to answer by the teacher. Students are active in discussing through the group whatsapp group discussing the tasks being carried out as shown in Figure 4.



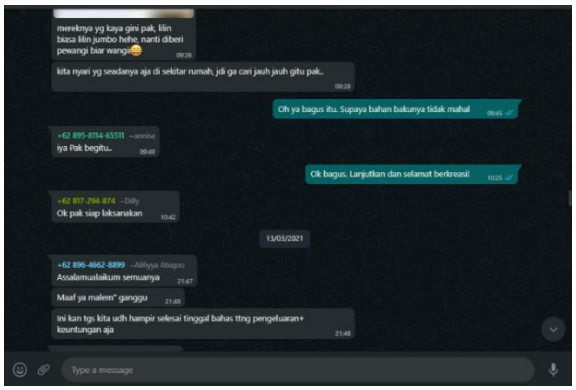


Figure 4. Student Activity in Discussion

Entrepreneurial products developed by students are diverse. Products made by students include aromatherapy candles, banana nuggets, crispy apple donuts, and potato chips balado. The creativity of students is challenged through the manufacture of this product. Students look for materials and work steps for making products in groups through their respective references. Products made by students are presented in Figures 5, 6, 7, 8, and 9.

Figure 5. Group 1 Products, Aromatherapy Candles

Figure 6. Group 2 Products, Banana Nuggets

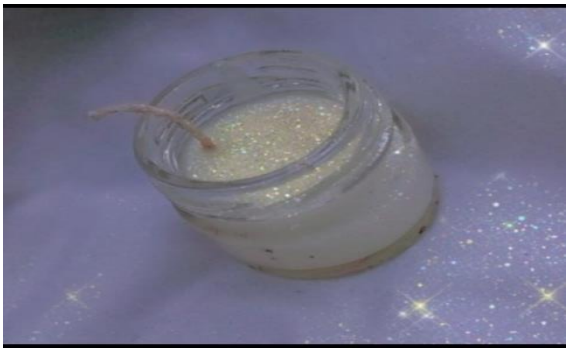


Figure 7. Group 3 Products, Aromatherapy Candles

Figure 8. Group 4 Products, Potato Donuts

Figure 9. Group 5 Products, Potato Chips Balado

Students are given daily test or evaluation at the end of the lesson to analyze abilities cognitive. The cognitive abilities of students after learning are measured by 15 questions multiple choice test. The results of the cognitive evaluation of the implementation class are presented in Table 3 and the recapitulation shown in Table 4.

Table 3. Results of Cognitive Evaluation Implementation Class

Subject	Score	Subject	Score
S-01	80	S-16	73
S-02	80	S-17	73
S-03	73	S-18	73
S-04	73	S-19	80
S-05	80	S-20	80
S-06	87	S-21	73
S-07	73	S-22	80
S-08	80	S-23	73
S-09	80	S-24	67
S-10	80	S-25	53
S-11	73	S-26	80
S-12	80	S-27	53
S-13	80	S-28	67
S-14	80	S-29	73
S-15	80	S-30	73

Table 4. Recapulation of Results

No	Criteria	Score
1	Highest score	87
2	Lowest score	53
3	Average score	75
4	Passed	26
5	Not passed	4
6	Total subject	30
7	Percentage	87%

The results of the cognitive test of 30 students showed that the highest score was 87 and the lowest score was 53. The average value of the student test results was 75. A total of 26 students completed the KKM while 4 students did not complete the KKM so that there were 87% of the total participants. students in the classroom complete cognitive tests.

CONCLUSION

Based on the results and discussion of chemo-entrepreneurship-oriented teaching material design research to analyze the cognitive ability of students on redox material and nomenclature of chemical compounds, it can be concluded that:

1. The teaching materials developed are adapted to the orientation of chemo-entrepreneurship learning on redox material and class X compound nomenclature. The developed teaching materials contain redox materials and chemical compound nomenclature, entrepreneurial learning orientation, exercises, and learning outputs in the form of entrepreneurial project.
2. The teaching materials developed are effective for analysing the cognitive abilities of students. The cognitive abilities of students are high with 26 students completing the minimum score out of a total of 30 students. The percentage of classical completeness is 87%. While the average test score of students is 75. The results of the analysis of students' cognitive abilities showed that the highest score obtained was 87 and the lowest was 53. The average value of the students' test results was 75 with 26 of 30 students or 87% completed the KKM. Also, students are active in discussing and making entrepreneurial products related to redox reactions including aromatherapy candles, banana nuggets, apple donuts, and potato chips balado.

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